Escola Politècnica Superior
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DESIGN AND CONSTRUCTION OF GLASS BOTTLE LINE PRODUCTION MECHANISM

MECHANICAL ENGINEERING

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CONTENTS

1. Originality of the project

Non-existent device on the market, developed to meet the specific needs of a particular factory.

2. Motivation

This project has allowed me to finish my studies in engineering and has also taken part of a real project. It has required dealing with suppliers to purchase some of the components that make up the device, making the design of some of its parts and developing the economic study for funding.

Acquired knowledge has been useful to make this project, and also to make a first step in the engineering environment.

3. Utility

This device is thought to be used in a concrete production plant and also makes possible the transportation of bottles in depalletizing process, making it useful for companies in the sector with a similar arrangement to that of *Castellar Vidrio*.

4. *Reescogido* process

In the process of manufacturing glass bottles in *Castellar Vidrio*, quality control is performed along the whole production line. In each area, specific controls are carried out to ensure a quality product to the final customer. Given the volume produced, rising on one line to 400 bottles per minute, becomes a highly expensive task to control each and every one of the bottles produced whereby the product control is performed timed in each of the matrices and random throughout the batch. Even so, there is available machinery, capable of individually analyzing some of the control

parameters, such as glass thickness, diameter mouth, verticality, etc. This is the process called chosen.

As it is unable to analyze some of the parameters for all the bottles, sometimes, when anomalies are detected, some production has already been palletized and stored, which leads us to have nonconforming material in the warehouse with the relevant cost of storage.

To reduce the amount of nonconforming stored material, *reescogido* process is done, consisting in depalletizing such pallets and reintroducing the bottles in the production line.

This automatic inspection machines are programmed to reject defective bottles, labeled with its code number that machines can read. It must be noted that before depalletizing pallet, we must make it sure that we are not producing the bottle number to be programmed as refusing product, as the anomaly will have been rectified and this bottle number shall comply at the time of *reescogido*.

5. Objeto

This project is drawn up in order to study and improve *reescogido* process in *Castellar Vidrio*.

6. Background

Reescogido process is part of manufacturing and aims to reduce non-conforming material in store.

This process consists in depalletizing a pallet and putting it back on the production line so that inspection machines eliminate the numbers of defective molds that cause the pallets to be considered nonconforming material.

6.1. Manually

Currently, in Castellar Glass depalletizing process is done manually, as seen in Figure 2.1.1., on all lines and any kind of bottle.

This methodology, arranging the pallet next to the table and moving the bottles manually, is time consuming and involves operator fatigue by the continuous repetition of the same movement.

Fig.2.1.1.

6.2. With frame

In the period between September and December 2014, some of the shifts implemented a system only valid for line 21, capable of making de *reescogido* process in a specific level. In Figure 2.2.1. you can see the process, which requires a forklift and a framework.

Fig. 2.2.1.

This system comes into disuse as it is not suitable for all operator given its weight, poor ergonomics and require forklift operator title.

7. Location

Reescogido process is performed in the cold glass area, between the output of the ark (where the annealing is performed), and authomatic inspection machines (MIA's).

8. Objectives

The objective of this project is to improve the *reescogido* process by acquiring a weightless manipulator and designing a useful device to form the INMA. Semiautomatic, transportable and able to *reescoger* any type of bottle in any of the seven lines of *Castellar Vidrio*.

INMA should be able to be manipulated by a single operator because it would be difficult to allocate more than one operator per shift to this purpose.

INMA is to reduce time to void the pallet, increasing the number of pallets *reescogidos* per shift, getting the task of *reescoger* more productive and providing an improvement to the operator ergonomics.

The estimated timeline for implementing the manipulator INMA in the *reescogido* process is fixed, as shown in the timing (point 12), 26.6.2015.

9. Project

Based on a need for improvement, the project began observing systems used to date to have a starting point on which would be the needs of the task *reescogido*.

Subsequently access conditions will be evaluated in each of the possible points of *reescogido* as well as the capability of accumulation tables, to gauge the appropriate handler and apply an appropriate system.

10. The manipulator

10.1. Needs assessment

Using the manipulator, we must be able to access the top of one of the highest pallets that are palletized in *Castellar Vidrio*.

One of the highest palletized pallets is model BD NOVA bottle 75 with a height of 2300mm as shown in Figure 6.1.1.

Número de alturas:	7
Número de unidades:	1624
Altura total:	2,30 m.
Dimensiones de la base:	1200 x 1000 mm.
Peso total:	660 Kg.
Observaciones:	

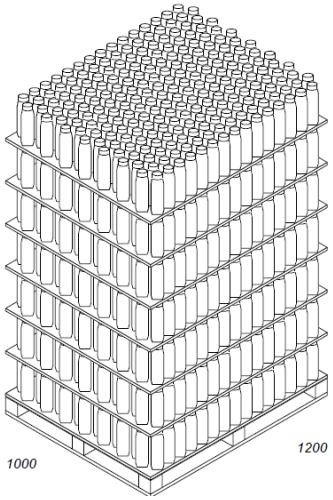


Fig. 6.1.1.

From this dimensional requirement, the structure must comply with the specified dimensions in Figure 6.1.2.

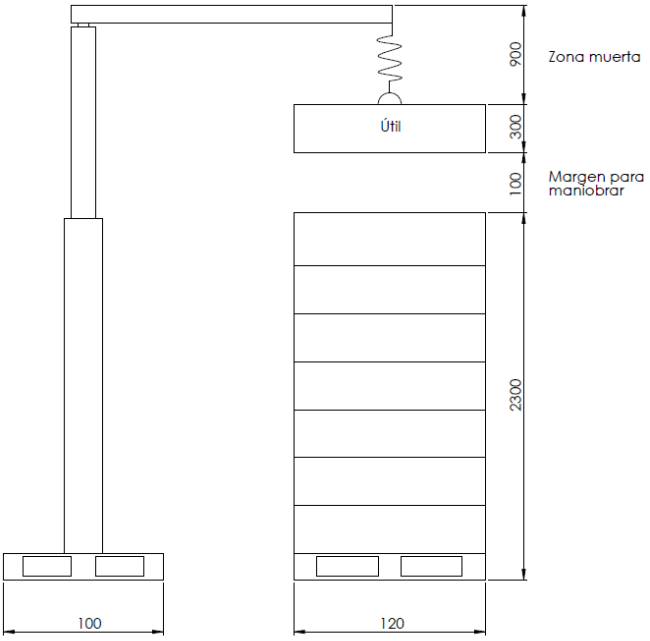


Fig. 6.1.2.

10.2. The chosen manipulator

The structure that best suits the needs is the PVC-A20 (SB) DALMEC, Manipuladores Industriales, S.L. (Figura 7.2.1.).

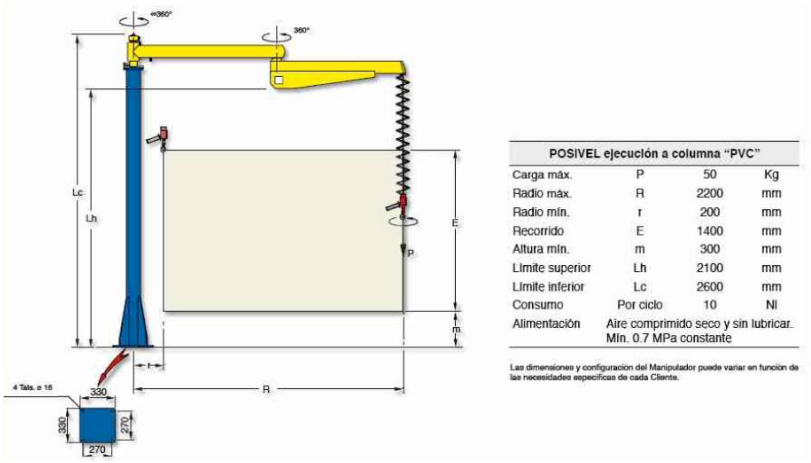


Fig. 6.2.1.

This structure allows the displacement of weightless charges operates with compressed air, a requirement with any inconvenience due to the ease of adjusting points *reescogido* one socket to it, to dispose of it in the whole plant.

The fact of working with this system means that a single operator has the autonomy to transport the structure by freestanding mobile base (Figure 6.2.2.), and connects this without the intervention of a technician.

Fig. 6.2.2.

The structure of Figure 6.2.1. it can assemble the tool developed also providing all necessary air intakes for its use and can modify its height to suit the dimensional requirements set out in Figure 6.1.2..

We must be noted that the vertical hook travel is limited to 1400mm. Given this limitation we will have to climb the mast structure to 3600mm to access the upper layers of the pallets and to access the lower it will have to be lifted. For this the use of an electric stacker is proposed as the following figure.

Use of this stacker and not another is conditioned by the type of pallets used for palletizing bottles. These pallets are ANIFE (Figure 6.2.4.) and the VMF (Figure 6.2.5.). Both have the same measures, 1000x1200mm, and are characterized by crossbars at the bottom on all four sides. This handicap conditions which machinery has to be used to raise such pallets to a forklift or a free stacker in the vertical blade.

Fig. 6.2.4.

Fig. 6.2.5.

11. The device

11.1. Prototype

In order to *reescoger* any type of bottle in any of the lines it has been developed a prototype (Figure 7.1.1.) capable of exchanging quickly and easily tires depending on the size of the bottles (small or big) to be *reescogidas*.

This prototype also meets the requirement to be used by a single operator and the various needs of the lines as the accumulation table does not have the same capacity in each of them and therefore the number of rows of bottles will be variable.

This device, is manufactured with disposable material found in the store regardless of the type of material and the final dimensions of the device.

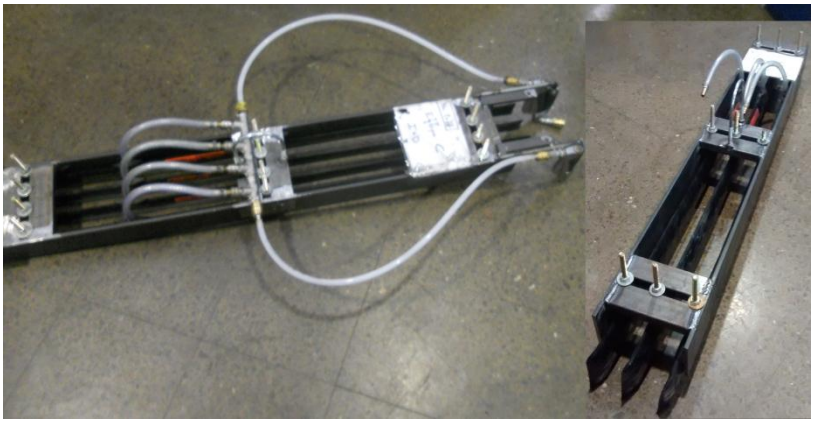


Fig. 7.1.1.

The prototype has two handles with double function, which are: directing the structure to catch and release the bottles and the inflation and deflation of tires.

One of the handles is connected to the compressed air and when it is activated, the air reaches the distributor, which is responsible of distributing the air to all tires. When you release the inflation handle, the air inside the tire is maintained at constant pressure, a fact that guarantees not to lose any bottle during transport.

When operating the other handle, free air escapes into the atmosphere with enough speed to release all bottles simultaneously.

11.2. Tests with the prototype

For testing, we used a hydraulic crane as manipulator like Figure 7.2.1 . This system does not confer the necessary sensitivity for such a task and requires two operators, one manipulating the crane and another one manipulating the device.

Fig. 7.2.1.

The following sequence of images (7.2.2.) shows the process with successful outcome of large bottle *reescogido*. No difficulties were found in any part of the *reescogido* process.

Fig. 7.2.2.

In the sequence of Figure 7.2.3. appears the test made with small bottle on the line 20. Difficulties in this case appeared when the device was stabilized to take the bottles and we observed an increase in susceptibility of the bottles to fall if not released in alignment to the conveyor's movement. These difficulties will be minimized with a device with more stability and a manipulator with greater sensitivity.

Fig. 7.2.3.

11.3. Studying depalletization times

With the tests done with the prototype of the device and using a hydraulic crane, there have been done *reescogido* time measurements of small and big bottle pallet, and we have compared the results with the *reescogido* process done manually. Better results are expected with the INMA device and we can observe the results in the table below.

	DEPALLETIZATION	
	Small bottle (minutes)	Big bottle (minutes)
Current system	85	35
Prototype	55	25
INMA	40	15

Expected improvements with the use of the device are given by INMA greater maneuverability with the weightless manipulator and also greater stability and practicality of the device.

11.4. Material Selection

Material used to build the structure as the limiting plates of tire travel is stainless steel, to prevent future shedding oxide that may contaminate the interior of the bottles.

There are many types of stainless steel and not all are suitable for structural applications, particularly when carrying out welding operations.

Austenitic stainless steels are generally the most commonly used in structural applications, providing a good combination of corrosion resistance and fabrication properties.

Occasionally the device will be exposed to residual chemicals in the atmosphere from the bottles chemical surface treatment, the addition of molybdenum increases the corrosion resistance, such as the AISI 316.

In the food industry it is enough to use the AISI 304, 304L, 316 and 316L types. Both AISI 316 and AISI 316L IT are to resist corrosion pitting and intergranular, however the use of AISI 316L material is advised when working in cold, room temperature or up to 200oC to 200oC over services we recommend using AISI 316 Ti, so that the material used for the construction of the device will be the AISI 316L.

Properties	**Value**	**Units**
Elastic modulus	2,00E+11	N/m^2
Poisson coefficient	0.265	N/D
Shear modulus	8.2e+010	N/m^2
Density	8027	kg/m^3
Tensile Strength	485000000	N/m^2
Elastic limit	170000000	N/m^2
Coefficient of thermal expansion	1.65e-005	/K
Thermal conductivity	14.6	W/(m·K)
Specific heat	450	J/(kg·K)

AISI 316L

11.5. Design of device for *Castellar Vidrio*

Device's structure designed (Figure 7.5.1.) has a railing around the perimeter where it will be manipulated by the operator and which should be arranged controls inflation and deflation of the tires. This is sized to install up to six tires that allow carrying five rows of small bottles. In the case of large bottles *reescogido*, the number of rows of bottles to be transported is reduced to three or four, in the best case, depending on the bottle diameter.

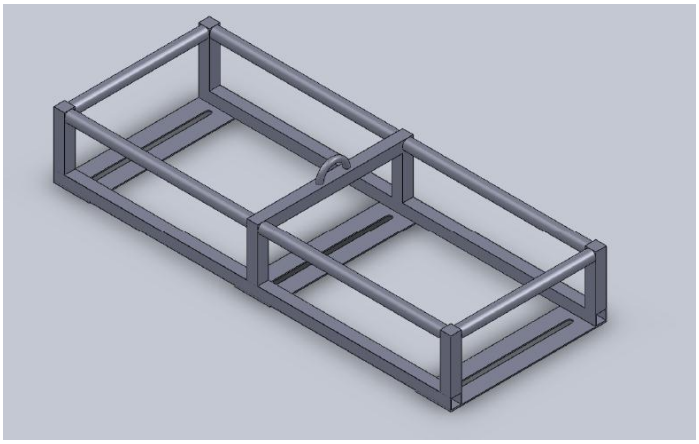
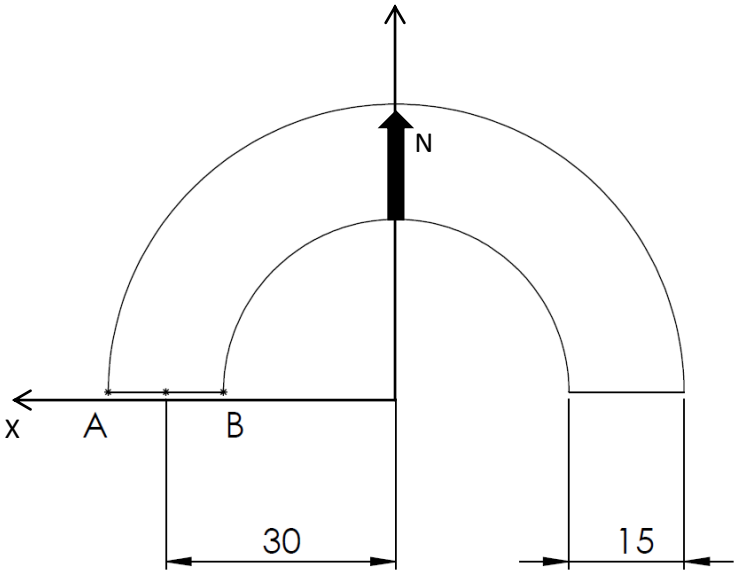


Fig. 7.5.1.

To hang the device on the structure we will provide it with an arc which will be suspended and below we can analyze it. It is contemplated that this will have to bear the weight of the device and also the weight of the bottles, thinking always about the worst of cases.



$$I = \frac{\pi \cdot r^4}{4}$$

$$I = \frac{\pi \cdot 7{,}5^4}{4} = 2485 mm^4$$

$$A = \frac{\pi \cdot d^2}{4}$$

$$A = \frac{\pi \cdot 15^2}{4} = 176{,}715 mm^2$$

$$N = (weight\_device + weight\_bottle) \cdot Fs \cdot g$$

$$N = (15 + 35) \cdot 2 \cdot 9{,}81 = 981N$$

$$M_x = N \cdot D$$

$$M_x = 981 \cdot 30 = 29.430 Nmm$$

$$\sigma = \frac{N}{A} + \frac{N_{Y_p}}{I_z} \cdot y + \frac{N_{X_p}}{I_y} \cdot x$$

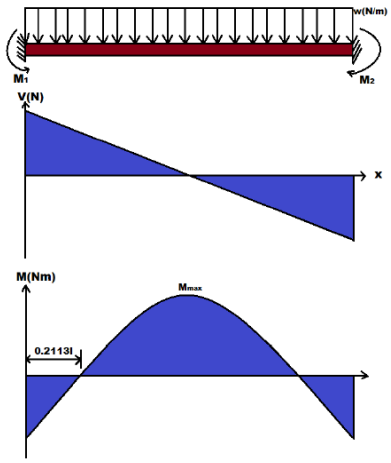
Given that y_p=0

$$\sigma_A = 600 \cdot \left[\frac{1}{176{,}715} + \frac{30}{2485} \cdot (7{,}5) \right] = 94{,}37 MPa$$

$$\sigma_B = 600 \cdot \left[\frac{1}{176{,}715} + \frac{30}{2485} \cdot (-7{,}5) \right] = -83{,}27 MPa$$

Now, we will analyze the plates placed at the bottom of the device where assembled tires will support the bottles. These are fixed-end beam and will support distributed loads, both the weight of bottles and itself. For the analysis of one of the plates, we divide bottles weight into three.

FREE-BODY DIAGRAM



$$W = own\_weight$$
$$N = bottle\_weight$$
$$P = \frac{own\_weight + bottle\_weight}{L}$$

$$P = \frac{\left(0{,}9kg + \frac{35kg}{3}\right) \cdot 9{,}81 \, {}^{m}/_{s^2}}{375mm} = 0{,}329 \, {}^{N}/_{mm}$$

By symmetry we know that reactions are equal:

$$\sum F_y = 0 \rightarrow 2R = 0{,}329 \, {}^{N}/_{mm} \cdot 375mm$$

$$R = 61{,}64N$$

To get the maximum time that symmetry finds the center point of the plate, the plate is halved and this will be discussed:

$$\sum M = 0 \rightarrow M_1 - R \cdot x + M = 0$$

$$M = 61{,}64x - M_1$$

Applying Navier-Bresse corresponding to the turns between the end and the middle of the plate:

$$\theta_2 = \theta_1 + \frac{1}{EI}\int_0^{L/2} M dx$$

Given that they will not produce turns to be an embedding:

$$0 = \frac{1}{EI}\int_0^{187,5} (61,64x - M_1)dx = \left[\frac{61,64x^2}{2} - M_1 x\right]_0^{187,5}$$

$$M_1 = 6057,19 Nmm$$

By the maximum time we can calculate the maximum deflection of the plate to be a parameter to be controlled.

$$v_2 = v_1 + \theta_1 \cdot x + \frac{1}{EI}\int_0^{L/2} M \cdot \left(\frac{L}{2} - x\right)dx$$

Being the fixed rotation and displacement equal to 0:

$$v_2 = \frac{1}{EI}\int_0^{187,5} (61,64x - 6057,19)\cdot(187,5 - x)dx$$

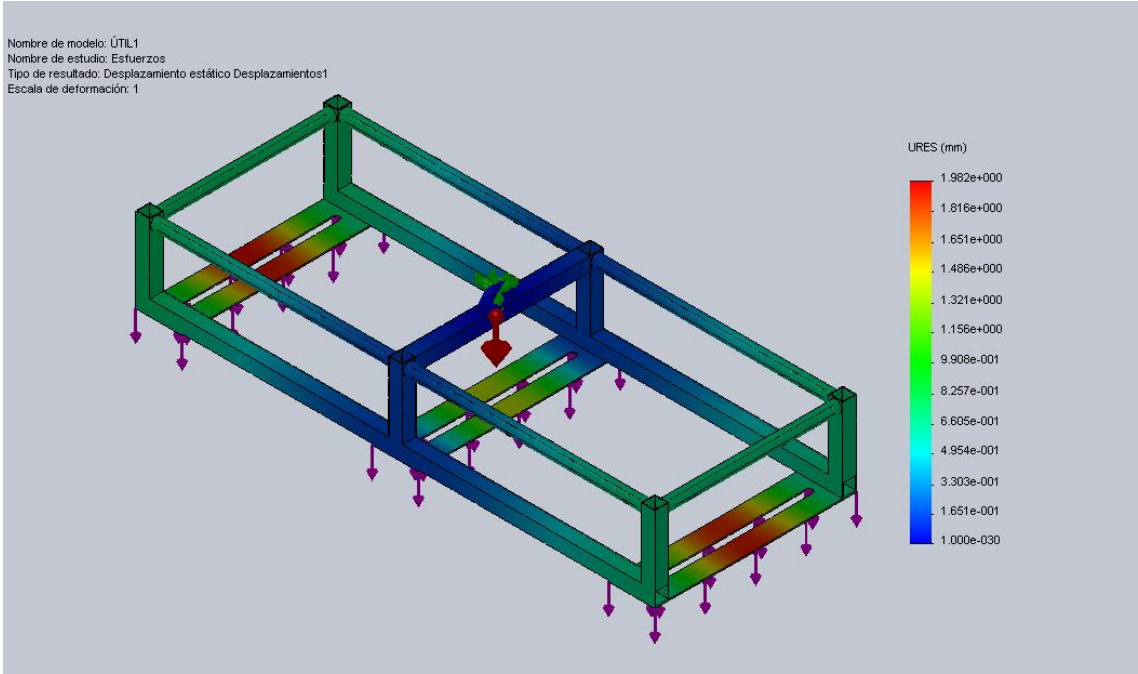
$$v_2 = \frac{1}{EI}\int_0^{187,5} 11.557,5x - 61,64x^2 - 1.135.723,125 + 6057,19x dx$$

$$v_2 = \frac{1}{EI}\left[\frac{11.557,5x^2}{2} - \frac{61,64x^3}{3} - 1.135.723,125x + \frac{6057,19x^2}{2}\right]_0^{187,5}$$

$$v_2 = \frac{1}{200000\,N/mm^2 \cdot 225mm^4}\cdot(-38.754.316,41)$$

$$v_2 = -0,86mm$$

In the following simulation the most sensitive point to be deformed can be seen,it is the central point of the plates, with a displacement of a millimeter.



We will calculate the maximum stresses in the plates to verify that the elastic limit is not exceeded these.

$$\sigma_{\max} = \frac{M \cdot c}{I}$$

Where

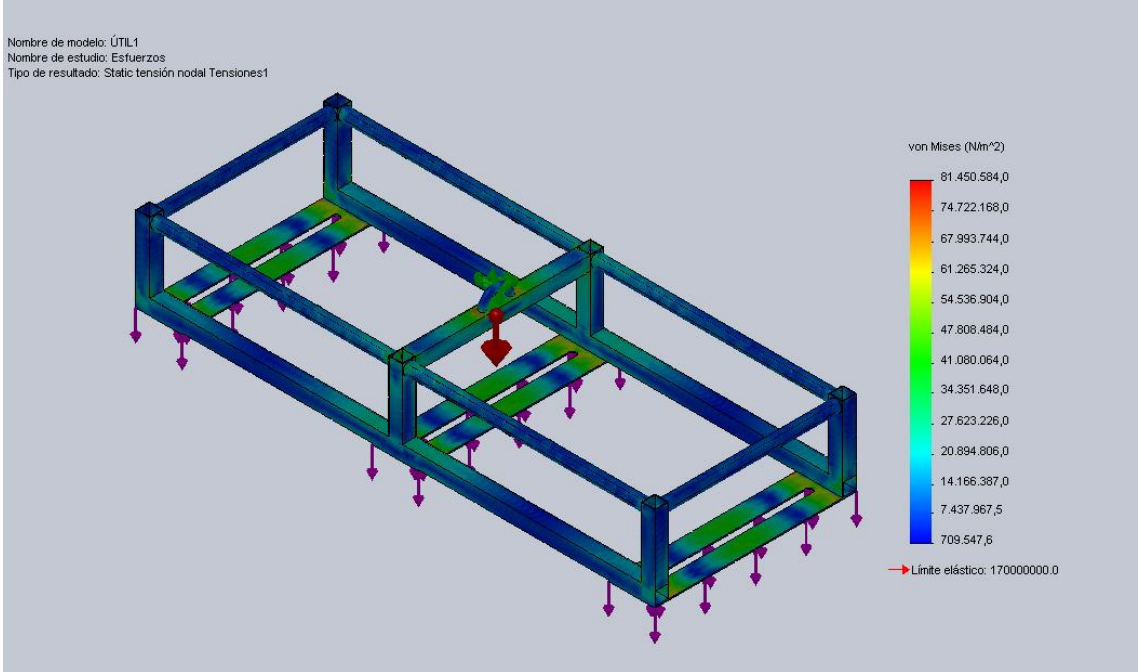
$$M = 6057{,}19 Nmm$$
$$c = 1{,}5 mm$$
$$I = 225 mm^4$$

$$\sigma_{\max} = \frac{6057{,}19 \cdot 1{,}5}{225} = 40{,}38 MPa$$

$$\tau_{\max} = \frac{3 \cdot R}{2 \cdot A}$$

$$\tau_{\max} = \frac{3 \cdot 61{,}64 N}{2 \cdot 300 mm^2} = 0{,}31 MPa$$

Below we can observe the results of the tensions simulation. We can note that nowhere in the structure exceeds the material yield strength.



Applying the Von Misses criterion for combined efforts we have:

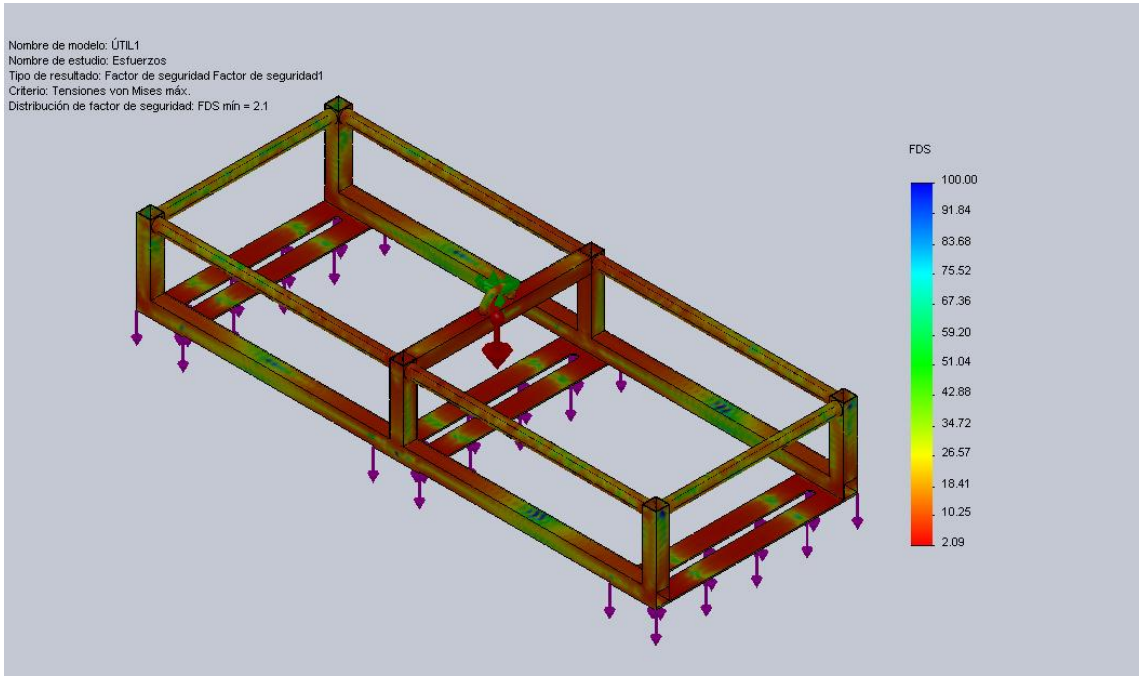
$$\sigma' = \sqrt{\sigma^2 + 3 \cdot \tau^2}$$

$$\sigma' = \sqrt{40{,}38^2 + 3 \cdot 0{,}31} = 40{,}38 MPa$$

$$\eta = \frac{S_y}{\sigma'}$$

$$\eta = \frac{170 MPa}{40{,}38 MPa} = 4{,}21$$

This safety factor value tells that the plate would support the load that will be submitted. In the following simulation it can be seen that the lower safety factor we find is 2 which guarantees the integrity of the structure.



As shown, the structure is able to withstand the stresses to which it will be subjected but given that its work will be continue, fatigue can weaken the critical points for what is considered optimal to increase the resistance of these.

To do so, the building material has been changed to another with higher elastic modulus.

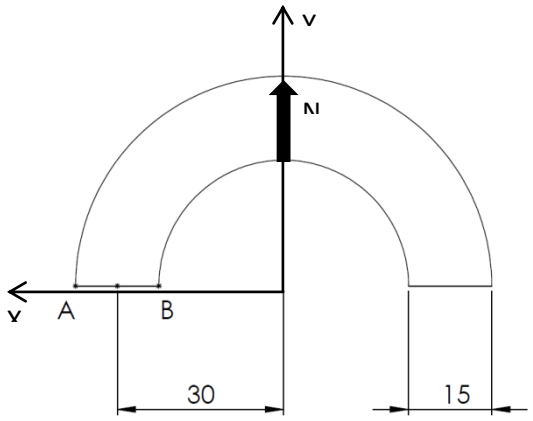
Since it is required to avoid corrosion of the structure to prevent contamination of the interior of containers with oxide particles, the chosen material is alloy steel. Once formed the structure, this will undergo a treatment of electrolytic zinc, which through electrolysis zinc deposit which does not exceed 20 microns is provided. The electrolytic treatment is better than the acid as it is free from cyanide, has a better distribution of thickness and increased corrosion resistance.

Properties	Value	Units
Elastic modulus	2,1e+11	N/m^2
Poisson coefficient	0.28	N/D
Shear modulus	7.9e+010	N/m^2
Density	7700	kg/m^3
Tensile Strength	723825600	N/m^2
Elastic limit	620422000	N/m^2
Coefficient of thermal expansion	1.3e-005	/K
Thermal conductivity	50	W/(m·K)
Specific heat	460	J/(kg·K)

Alloy steel

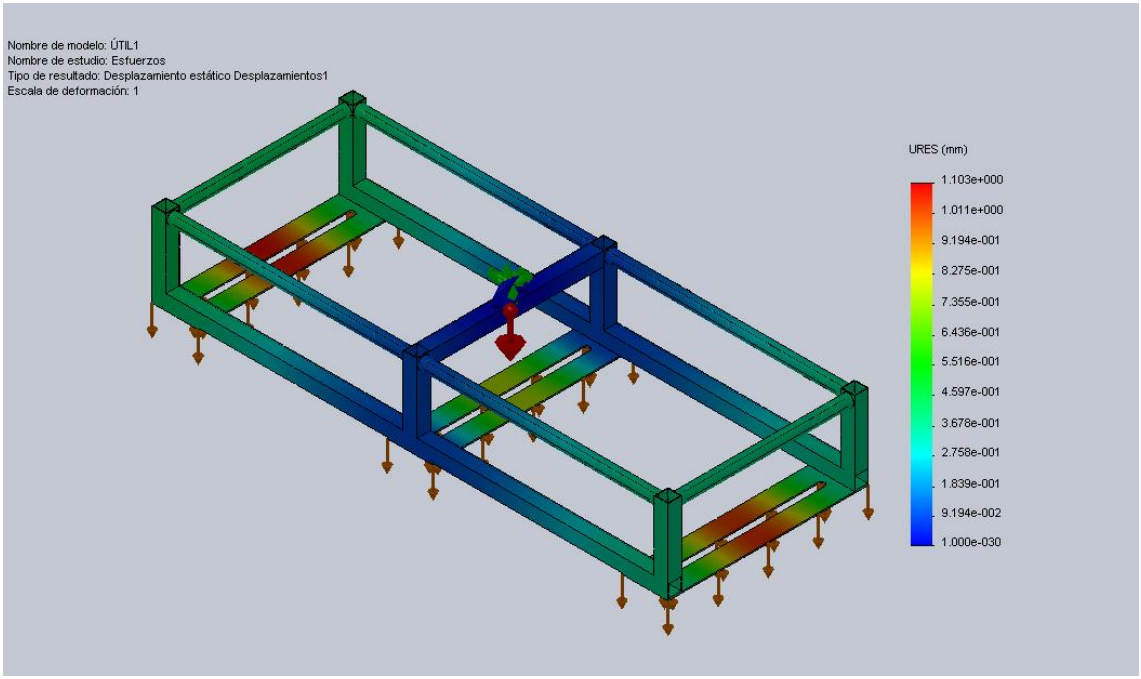
Designación numérica del acero	Tipo de acero según norma	Composición química (% en masa)									
		C	Si	Mn	P	S	N	Cr	Mo	Ni	Cr+Mo+Ni
10.511	EN 10083-2	0,37 ÷ 0,44	< 0,40	0,50 ÷ 0,80	< 0,045	< 0,045	-	< 0,40	< 0,10	< 0,40	< 0,63

Calculations of the critical points:



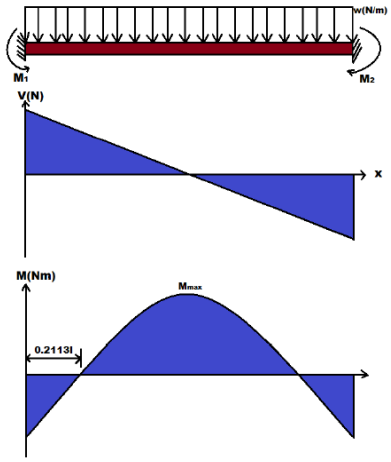
Since both the geometry and the load are equal, the tension at points A and B are the same, but with steel alloy there will be less strain on these points.

The next image corresponds to the simulated strain image of the structure where you can see how it will not produce any deformation in the points A and B even having tension.



Analyzing below the bottom plates:

FREE-BODY DIAGRAM



$$W = own\_weight$$

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$$P = \frac{own\_weight + bottle\_weight}{L}$$

$$P = \frac{\left(0{,}9kg + \frac{35kg}{3}\right) \cdot 9{,}81 \, {}^{m}\!/_{s^2}}{375mm} = 0{,}329 \, {}^{N}\!/_{mm}$$

By symmetry we know that reactions are equal:

$$\sum F_y = 0 \rightarrow 2R = 0{,}329 \, {}^{N}\!/_{mm} \cdot 375mm$$

$$R = 61{,}64N$$

To get the maximum momentum that symmetry finds the center point of the plate, the plate is halved and this will be discussed:

$$\sum M = 0 \rightarrow M_1 - R \cdot x + M = 0$$

$$M = 61{,}64x - M_1$$

Applying Navier-Bresse corresponding to the turns between the end and the middle of the plate:

$$\theta_2 = \theta_1 + \frac{1}{EI} \int_0^{L/2} M dx$$

Given that they will not produce turns to be an embedding:

$$0 = \frac{1}{EI} \int_0^{187{,}5} (61{,}64x - M_1) dx = \left[\frac{61{,}64x^2}{2} - M_1 x \right]_0^{187{,}5}$$

$$M_1 = 6057{,}19Nmm$$

By the maximum momentum we can calculate the maximum deflection of the plate to be a parameter to be controlled.

$$v_2 = v_1 + \theta_1 \cdot x + \frac{1}{EI} \int_0^{L/2} M \cdot \left(\frac{L}{2} - x \right) dx$$

It is at the fixed, rotation and displacement equal to 0:

$$v_2 = \frac{1}{EI}\int_0^{187,5}(61,64x - 6057,19)\cdot(187,5 - x)dx$$

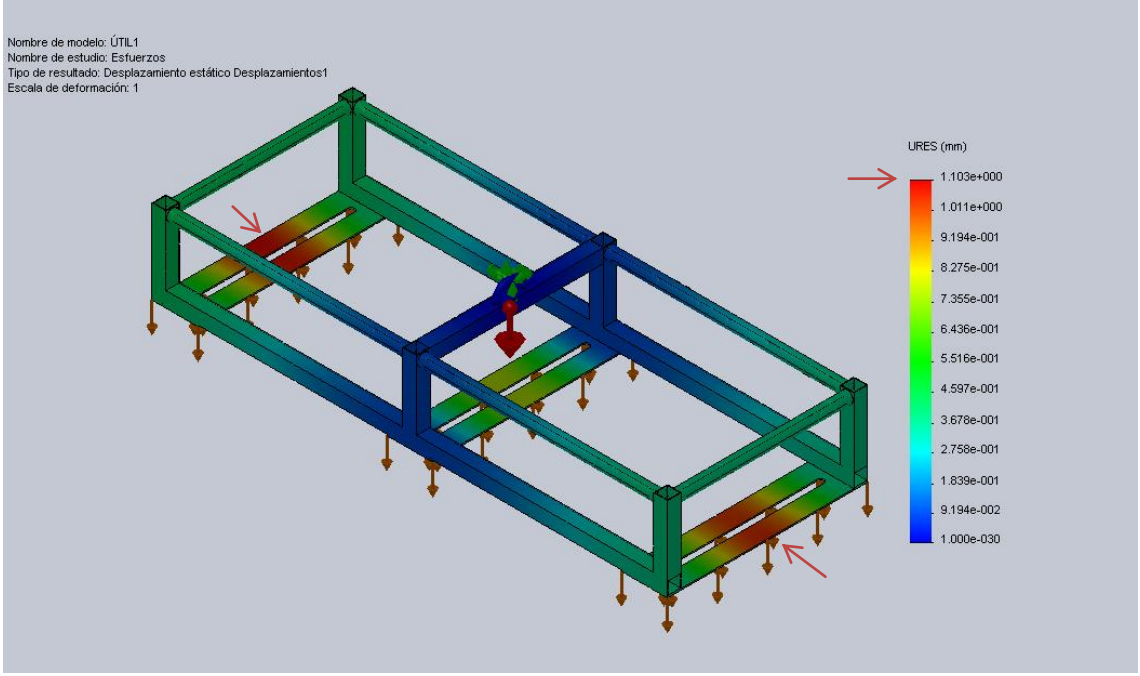
$$v_2 = \frac{1}{EI}\int_0^{187,5}11.557,5x - 61,64x^2 - 1.135.723,125 + 6057,19xdx$$

$$v_2 = \frac{1}{EI}\left[\frac{11.557,5x^2}{2} - \frac{61,64x^3}{3} - 1.135.723,125x + \frac{6057,19x^2}{2}\right]_0^{187,5}$$

$$v_2 = \frac{1}{210000\,{}^{N}\!/_{mm^2}\cdot 225mm^4}\cdot(-38.754.316,41)$$

$$v_2 = -0,82mm$$

In this case the bending at the center point of the plates is reduced theoretically in 4 hundredths of a millimeter. In the simulation we see that this value varies a bit, still considering this, approximately one millimeter, as acceptable.



Calculation of the maximum stresses in the plates:

$$\sigma_{max} = \frac{M \cdot c}{I}$$

Where

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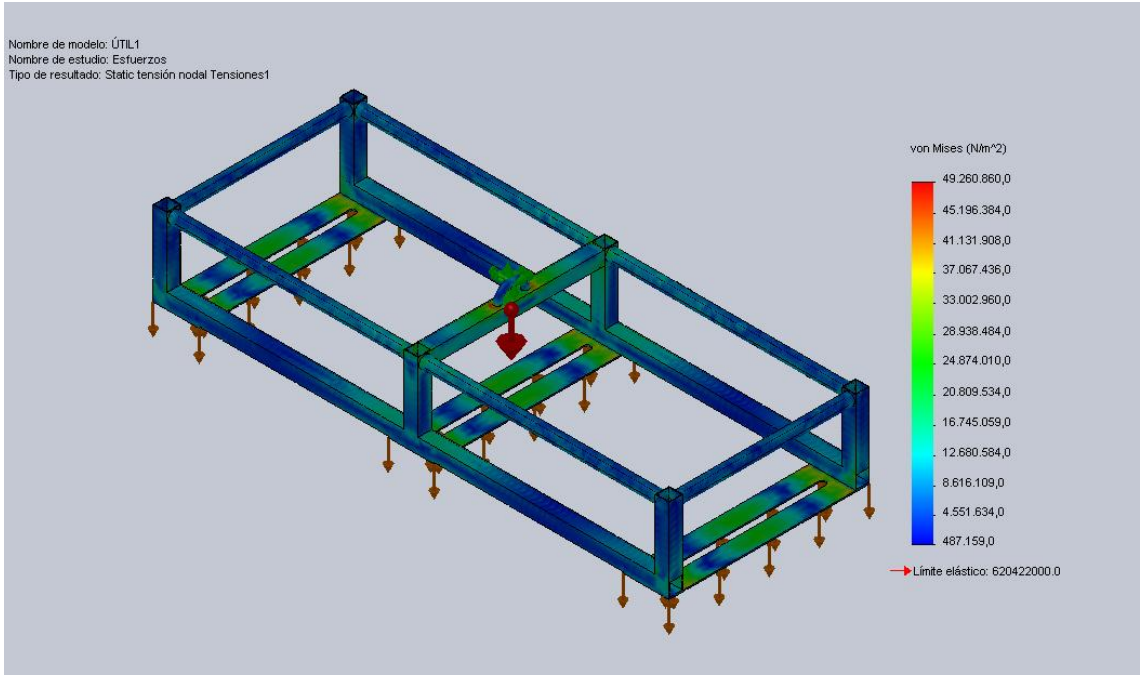
$$\sigma_{max} = \frac{6057{,}19 \cdot 1{,}5}{225} = 40{,}38 MPa$$

$$\tau_{max} = \frac{3 \cdot R}{2 \cdot A}$$

$$\tau_{max} = \frac{3 \cdot 61{,}64 N}{2 \cdot 300 mm^2} = 0{,}31 MPa$$

In the simulation of stress, we can see how most of the tension has decreased from 89MPa to 49MPa, with the yield of 620,42MPa.



Applying the Von Misses criterion for combined efforts have:

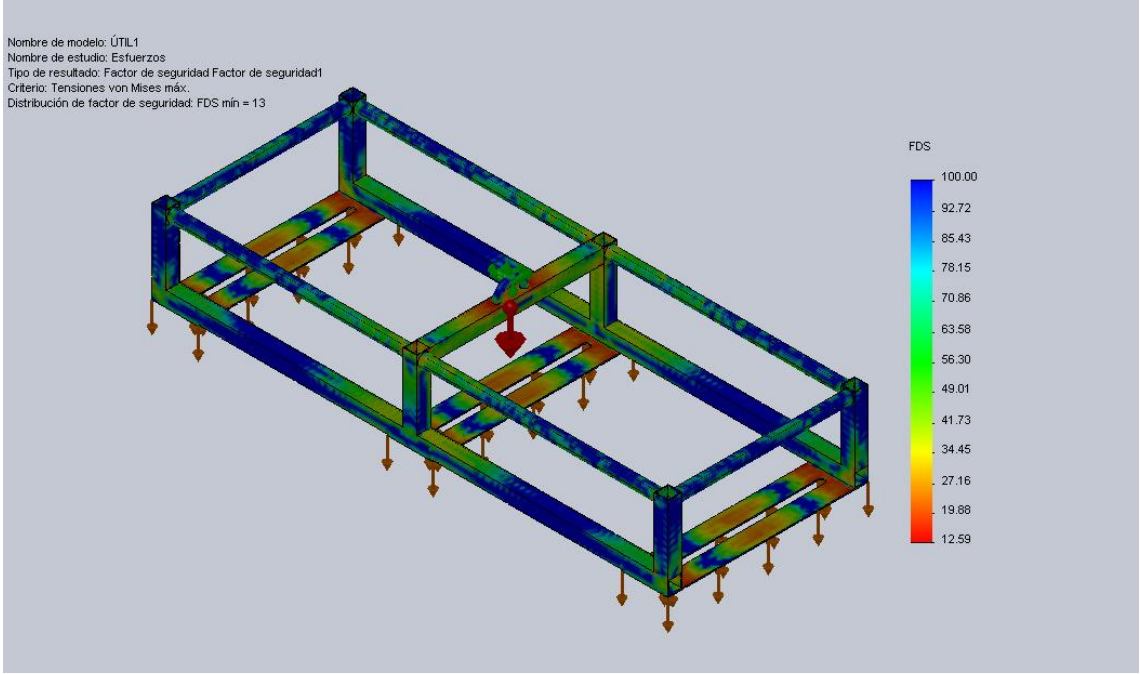
$$\sigma' = \sqrt{\sigma^2 + 3 \cdot \tau^2}$$

$$\sigma' = \sqrt{40{,}38^2 + 3 \cdot 0{,}31} = 40{,}38 MPa$$

$$\eta = \frac{S_y}{\sigma'}$$

$$\eta = \frac{620{,}42 MPa}{40{,}38 MPa} = 15{,}36$$

With the change of material made, a significant increase in the theoretical safety factor is appreciated. In the simulation performed, you can see that there is a minimum safety factor of 13. These ensure that the structure will withstand the stresses to which it will be subjected.



To prevent imbalance of the rows when inflating ultimate tires, a plate (Figure 7.5.2.) will be available at each extreme, the height of which will vary depending on the tire installed and therefore it is also contemplated as an element to exchange when replacing the tire suitable for each type of bottle.

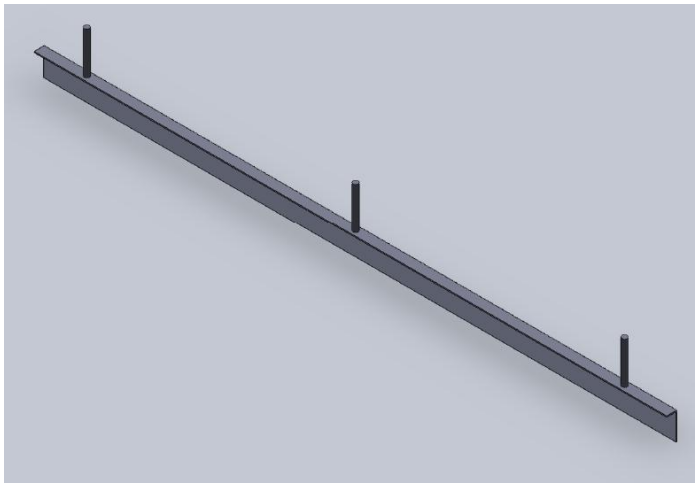


Fig. 7.5.2.

Through the manipulator arrives the air intake which allows the tire inflation. Air pressure for inflation will be regulated by a pressure regulator fixedly arranged in the structure and the air circulated by the different tires through an air distributor, with up to six outputs, also fixed on a plate in the structure in the central bridge (Figure 7.5.3).

The weight of the device will not exceed 15 kg allowing the manipulator to move up to 35 kg of bottles, margin more than enough, given the ability to take rows by the device being the weight in bottles between 30 and 35 kg, in the worst cases.

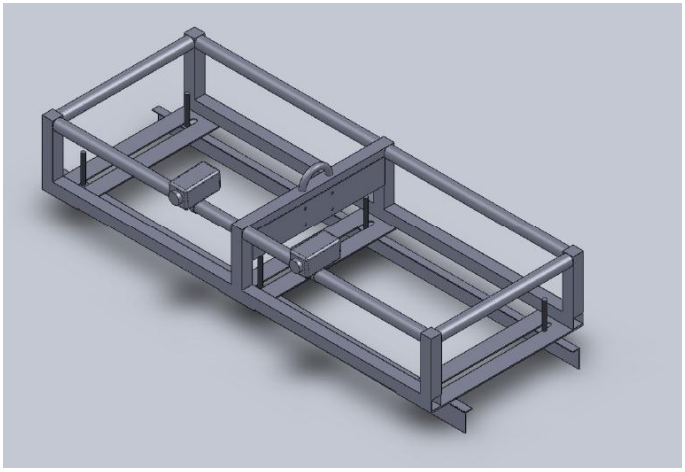


Fig.7.5.3.

11.6. Forming process device

The device comprises Ø25mm round tube, square tube 30x30mm and Ø15mm bent cylindrical rod. The junction points will be made by welding and the process used will be the welding electrode.

Welding steel pipes is executed using cellulosic electrodes, where high penetration is required and it must be easy to work the electrode. Beveled is always advised, with enough bevel angle sufficient for an almost complete introduction of the electrode into the welding groove.

Beveled:

- The bezel, the shoulder of the tube to be welded are prepared by the tubero or *pailero* using the angle grinder with disk ¼" with half-round file, checking the internal, external cleaning, the geometry of the edges with the calibrator or gage according to the procedure described.
- The bevel of the pipes with the same diameter but different thickness must be prepared taking the appropriate transition or reconstructing with welding according to code ASME Section VIII, Division I.
- The angle of the bevel is allowed between 30 and 45 in our case should be 37.5.
- The angle of the bevel is allowed between 60 and 90 in our case should be 75th.
- The shoulder or bead should be equal to the gap or space between the members and depends on the diameter of the electrode used in the root pass. In this case should be between 3/32 "and 1/8" and the electrode used should be 1/8".

11.7. Devices to adapt the device

To make useful the device we must have gadgets to adapt both airs pressure through a pressure regulator (Figure 7.7.1.1.) as an air distributor (Figure 7.7.2.1.) which will allow the distribution of air as homogeneously as possible.

11.7.1. Pressure regulator

The pressure regulator (LR Festo) will be provided with a manometer for monitoring tires pressure and with a hanging bracket to be attached to the device. The chosen regulator has a working range of 0.5 to 7 bar which is the pressure that operates the manipulator and supplies tires. Its maximum hysteresis 0.2bar allows us to adjust tire pressure more precisely as its maximum working pressure is 1,2bar. The connections between air intakes shall be established with quick connectors that we will have to adapt between the diameter given by the handler, the required by the pressure regulator and the required by the dealer. The technical characteristics of the regulator can be seen in Annex IV.

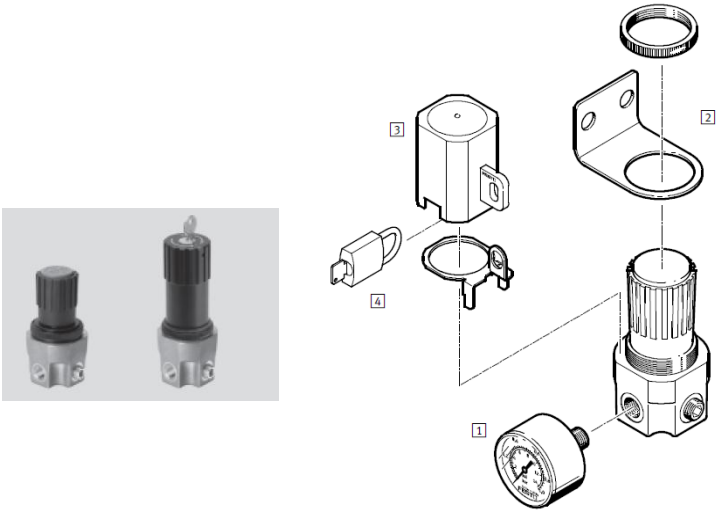


Fig 7.7.1.1.

11.7.2. Air distributor

A vacuum distributor is the chosen one: it ensures rapid evacuation of air from the tires to avoid the imbalance of the bottles carried at the time of the release, preventing the downfall of one of them. It has nine outlets and even if now only six are needed, it is preferable to leave some covered with the possibility of future requirement also having cleats and having to mount quick connectors for easy tire change.

Fig. 7.7.2.1.

11.7.3. Pneumatic

The tires used are normalized with what can be found on the market, by *Systemres* suppliers. As various models of bottles are manufactured, different tire sizes must be available to fit these collars of different bottles.

All tires have a total length of 1320mm and a maximum working pressure of 1,2bar, being height, the only variable parameter.

Tires used for *reescogido* are shown in Figure 7.7.3.1. Those allow catching most of the manufactured models. The diameter of these once swollen is 67mm, 37mm and 27mm respectively. Using one tire or another not only is given by the neck of the bottle but also by the diameter of these, because a tire too small results in misplacement of the bottles during transport and increases the risk of falling at the time of releasing them.

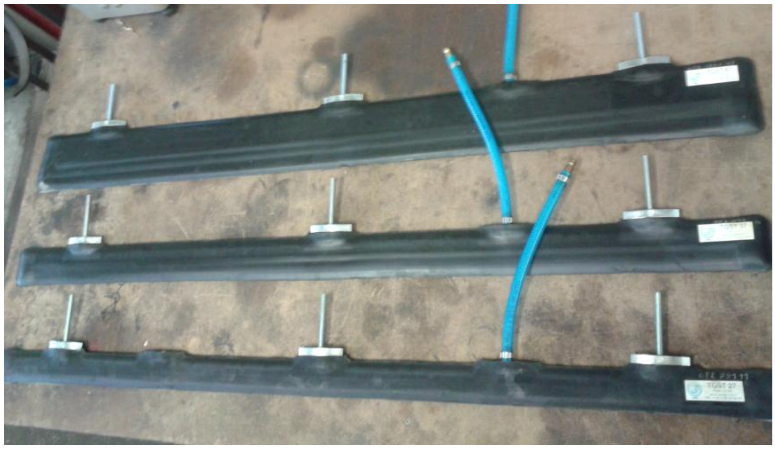
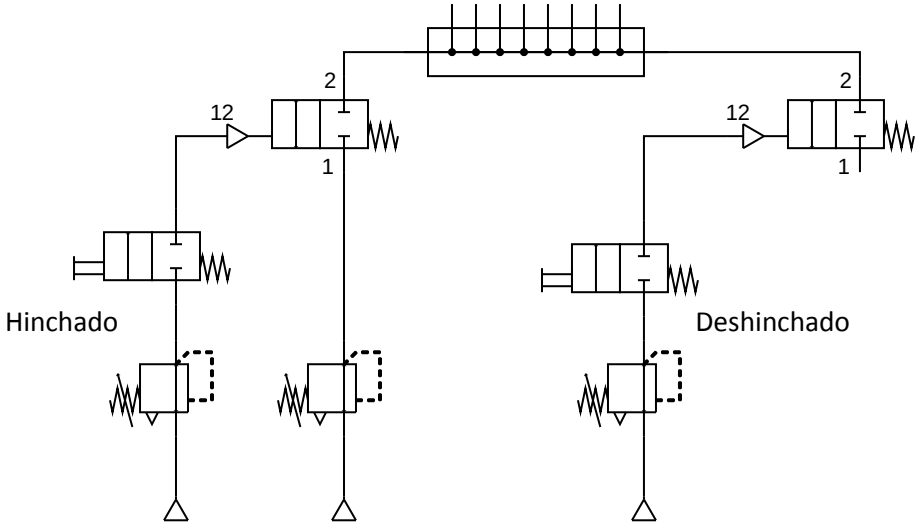


Fig. 7.7.3.1.

11.7.4. Pneumatic circuit

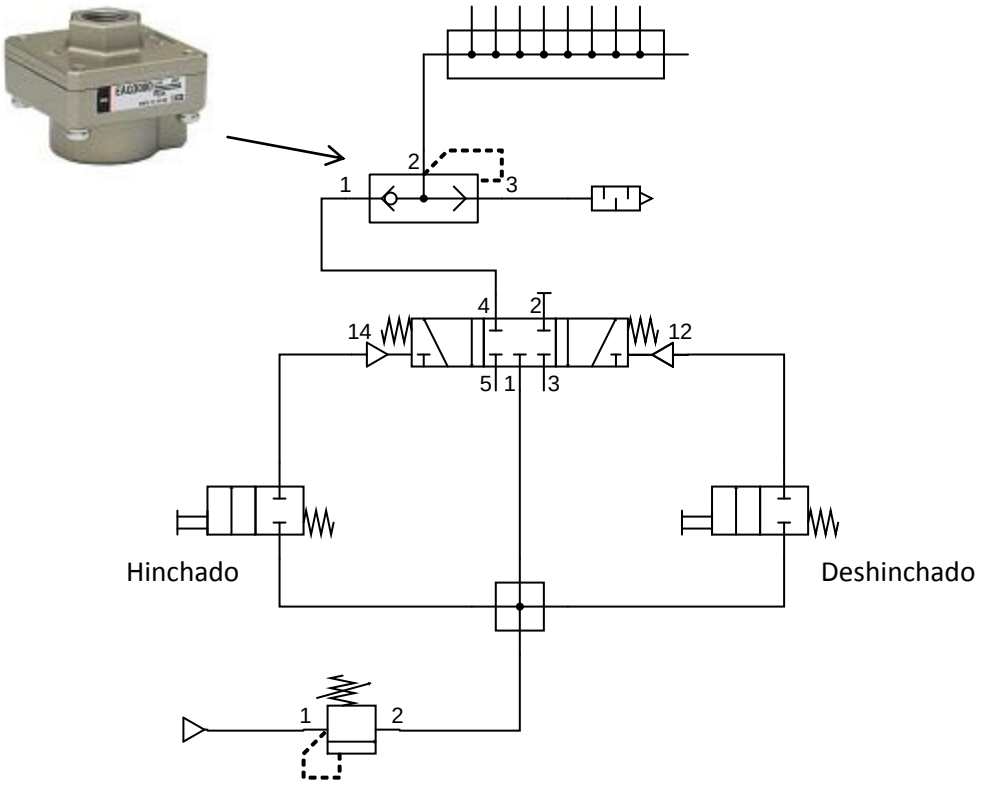


To avoid putting a vacuum device to accelerate the emptying process, there will be a 12mm diameter pipe with a valve sized for this so you can empty the tires with the same atmospheric pressure and at the desired time.

11.7.4.1. Tire testing circuit

When testing this circuit, it was found that the exhaust valve was not able to evacuate the air tires quickly enough, so we opted for a quick release valve.

Tests with the new pneumatic circuit, with the implementation of the quick release valve EAQ 2000 - F02 SMC were entirely satisfactory.

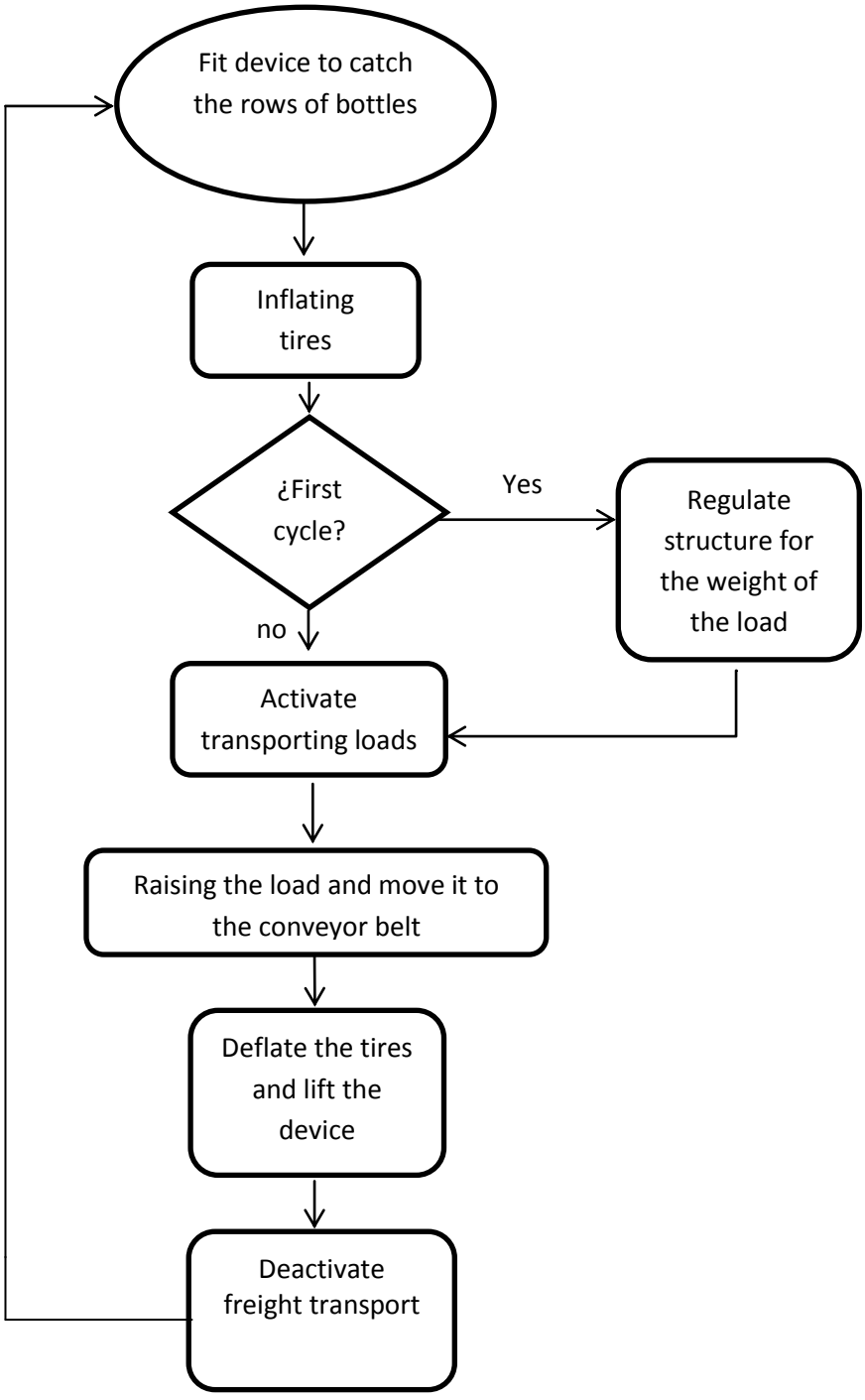


This circuit consists of the aforementioned pressure regulator, a push button inflation and a push button deflation, which pilot a 5/3 valve closed and the quick release valve (specifications in Annex III).

These modifications have managed to simplify the circuit, lowering costs and achieving the required functionality.

11.8. Description of the *reescogido*

In the next chart you can see the process of *reescogido* realized by the operator having previously prepared the pallet to *reescoger* and the manipulator INMA in the relevant line.



12. Line study

Line		*Reescogido* points	ACCESO Max. heigth(m)	ACCESO Max. width(m)	Pavement Access	Pavement Place	Rows of battles Small	Rows of battles Big
13								
	13.1	Pasillo	2	1,30	I	I	-	5
	13.2	Curva	2	1,30	I	I	-	4
12		Not reescoge	3,70	1,10	B	B	6	4
11								
	11.1	Final mesa salida de arca	2,50	1,50	I	B	-	3
	11.2	Ramal	2,50	1,50	I	I	-	1
23		Ramal	2,50	1,50	I	I	-	3
22		Ramal	Is not a problem	1,40	B	B	5	3
21		Ramal pasillo	Can be accessed by forklift		I	I	6	4
20		Desfiladero ramal 1	Can be accessed by forklift		I	B	5	3

I	Irregular
B	Good

13. Selection of alternative

Post online study three possible solutions are proposed to find physical limitations.

- Per line:

  It is based on the location of a fixed manipulator in each *reescogido* points of each of the lines. Each structure will have its device and specific tires for large and small bottle in the line, so if required we will have the possibility of making bottles different size. In this case the device can be adapted when changing model in hot area, saving time and possible problems later on, with the advantage that the operator bound to the *reescogido* task only has to transport the pallet and start the cycle. It is a system of high cost but I practical.

- Multipurpose manipulator:

  It is the answer to make polyvalent as much manipulators as possible given the proximity of different *reescogido* points in the different lines and the difficult, or impossible, access to some of them with freestanding mobile basis. Given the current provision and contemplating future structural changes, we would require 3 manipulators: one for line 13, another one shared between lines 11 and 23 and the third for the other lines. This provision would be used for three devices. This would increase time in the conditioning station *reescogido* with the advantage of avoiding certain modifications in layout, and wiring channels in cold area.

- A single manipulator:

  Use single manipulator and device for *reescogido* process in all lines which can be reached with the INMA manipulator. It does not require the adaptation of access lines or *reescogido* points. It is a significant reduction in costs but does not allow *reescogido* process on all lines.

In order to make objective decisions, a decision matrix is performed to quantify a final decision aimed to determine the impact of quantitative and qualitative form of the application of INMA system in relation to the current.

The assessment will take place from 1 to 5 quantifying the relevant parameters with 1 being very unfavorable to 5 very favorable.

SYSTEM / PARAMETER	PER LINE	POLYVALENT MANIPULATOR	SINGLE MANIPULATOR
MODIFICATION OF LAYOUT IN COLD AREA	1	5	5
COST OF DEVELOPMENT	1	3	5
OPERATOR TRINING	5	5	5
PRODUCTIVE CAPACITY	5	4	3
PROFIT FOR THE COMPANY	3	4	5
TOTAL	15	21	**23**

Being the single manipulator system the highest scored and the most economical, the final decision is to be implemented as a system.

In the study per line of point 9, it can be seen as access to the *reescogido* points proposed on lines 11, 13 and 23 is not possible without costly modifications in cold area layout so that *reescoger* is discarded, temporarily, by INMA manipulator in these.

By the manipulator and the proposed system, all objectives are settled except temporary *reescogido* in three of the lines for which, in future modifications, this need will be contemplated making appropriate adjustments so these can also make use of the manipulator INMA.

To *reescoger* on line 12 with that manipulator, electric stacker must be changed since there is a dimensional width limitation on the access of 1000mm, so we have opted for the acquisition of the model in Figure 9.1. Its width is 800mm, has load capacity of 1200 kg, being the heaviest pallet of 1000 kg, it can raise the type of pallets used in the plant and does not require forklift driving license to use it.

Fig. 9.1.

On the 5th of June tests were done with a stacker provided by Linde. For these tests the L16 version was used, with capacity of up to 1600 kg and 500 mm long. The maneuverability and stability tests were quite satisfactory so they were suitable for this project.

As buying this machine is expensive, it is decided to rent it, for a monthly cost of 390 € exempting this cost out of the project, as this machine may be used for other purposes in future.

The L 06-12 AC is an unusual stacker and if we consider the current economic situation, *Linde* makes product in order. The estimated delivery time is estimated by the dealer in 16 weeks so it will not be *reescogido* in line 12 until mid-October.

14. Environmental Impact

The use of metals involves a hard impact to the environment which goes from the mineral extraction to the end of the use of the product manufactured with it.

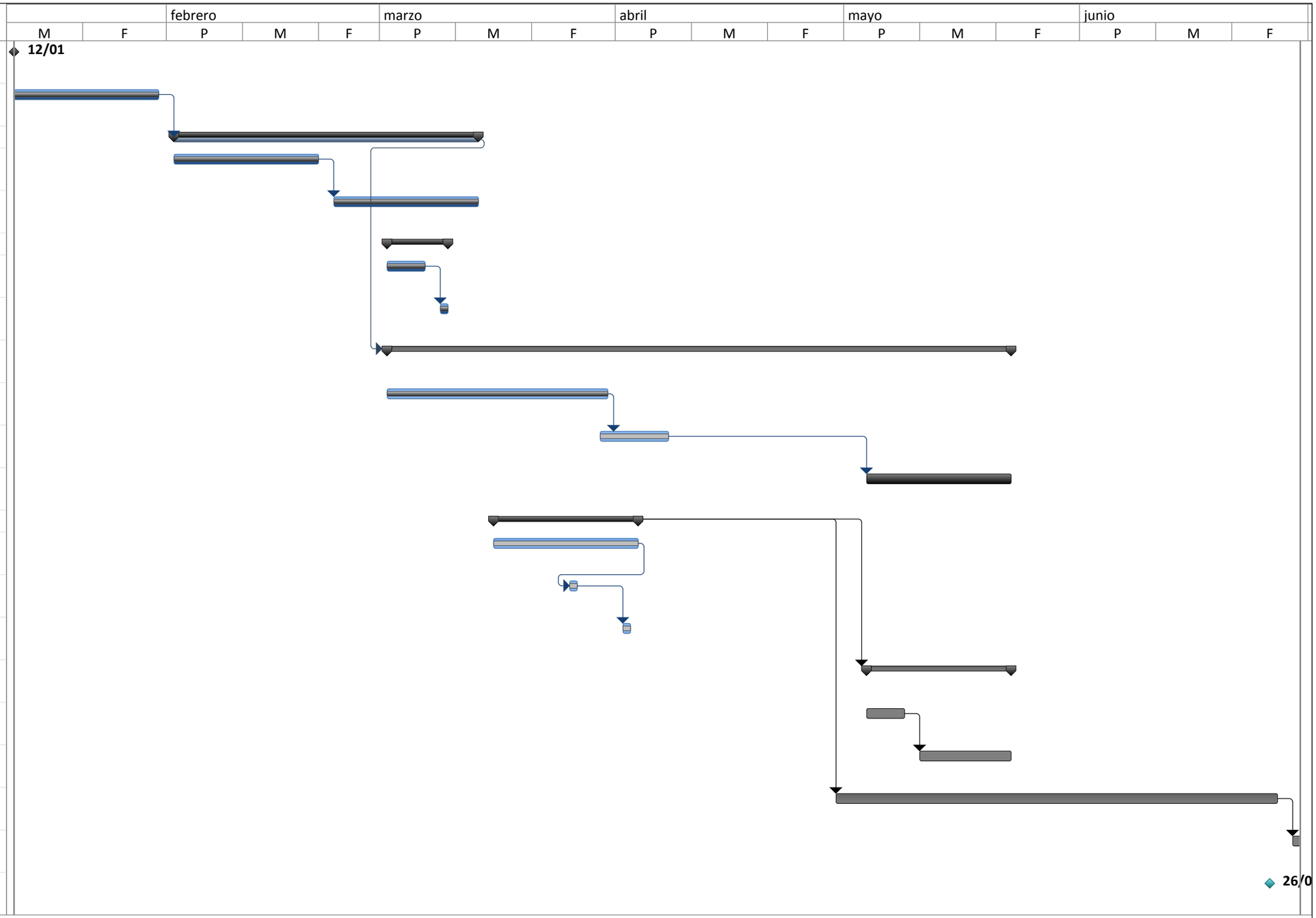
- During the extraction of minerals a major transformation of the landscape occurs by mining and by the accumulation of waste that contaminate the soil. In addition, there is a risk of acidification of rivers and groundwater from the discharge of wastewater from mines or mineral's washing.
- During manufacture of the product residues harmful substances result from the use of solvents, fats and acids used in the production process. They may result in acid rain due to emissions in foundries to the atmosphere sulfuric anhydride, nitrogen anhydrides and CO2, combined with cloud water which form acid compounds that fall to earth with rain or snow.

At the end of the life of the product, it must be managed properly. In the case of the structure and device designed, it will be picked up by a waste management company. Being entirely made of steel, they are 100% recyclable so they will be melted together with metals of the same nature and therefore reused.

The components of valves are made both thermoset and thermoplastic polymers and in the process to make them a complex process called polymerization is used and that process has numerous pollutant elements. These will also be recycled at the end of its life, a process performed by a waste management company.

The environmental impact of INMA device lies in obtaining building materials, the manufacturing process and recycling of these. In its use no lubrication fluids or other chemical or toxic agents are applied so that the impact during its lifetime will be negligible.

Id	Nombre de tarea	Duración
1	Project start	0 días
2	Rating systems used in other plants	15 días
3	**Prototype development**	**30 días**
4	Fabrication	15 días
5	Tests and improvements	15 días
6	**Election manipulator**	**6 días**
7	Choice of supplier	5 días
8	Visit the supplier	1 día
9	**Device development**	**60 días**
10	Design	21 días
11	Budget	7 días
12	Fabrication	15 días
13	**Decision making**	**15 días**
14	Study per line	15 días
15	Define definitive solution	1 día
16	Approval of budget	1 día
17	**Reescogido adaptation points**	**15 días**
18	Sectorization	5 días
19	Installing vents	10 días
20	Order of estructure	42 días
21	Starting the manipulator INMA	1 día
22	Home use INMA	0 días



Proyecto: Project
Fecha: 10/07/2015

Tarea	Tareas externas	Tarea manual	Sólo fin		
División	Hito externo	Sólo duración	Fecha límite		
Hito	Tarea inactiva	Informe de resumen manual	Retrasada		
Resumen	Hito inactivo	Resumen manual	Progreso		
Resumen del proyecto	Resumen inactivo	Sólo el comienzo			

16. Financial budget

ELEMENT	OBSERVATIONS	QTY.	PRICE (€/UNIT)	PRICE (€)
Manipulator PVC-A20	Specifications in annex 1	1	8654,00	8654,00
Standing base	Specifications in annex 1	1	3706,00	3706,00
Device for manipulating bottles	Specifications in annex 2	1	455,00	455,00
Adaptation of the device to the manipulator		1	1000,00	1000,00
Subdividing points *reescogido*		4	250,00	1000,00
Air intakes in points *reescogido*		4	250,00	1000,00
Modifications points *reescogido*		4	250,00	1000,00
Incidents		2%		336,30
			TOTAL	**17151,30**

17. ROI

The calculation of return on investment is taking as its premise the increase in one of the pallets *reescogidos* per shift for the period of one year.

Average weight per pallet ($\overline{p}$) = 0,75 T/pallet

Cost of ton storage (C_{ta}) = 190 €/T

Increasing annually pallets *reescogidos* = 365días x 3pallets/día = 1095 pallets

Investment cost = 17.151,30€

$$Benefit\,(€) = \overline{p} \times C_{ta} \times Pallets$$

$$Benefit\,(€) = 0{,}75(T/pallet) \times 190(€/T) \times 1095(pallets) = 156.037{,}50€$$

$$ROI\,(\%) = \frac{Benefit - Costs}{Costs} \times 100$$

$$ROI(\%) = \frac{156.037,50 - 17.151,30}{17.151,30} \times 100 = 809,77\%$$

The investment is profitable with a return for the company of 809,77%.

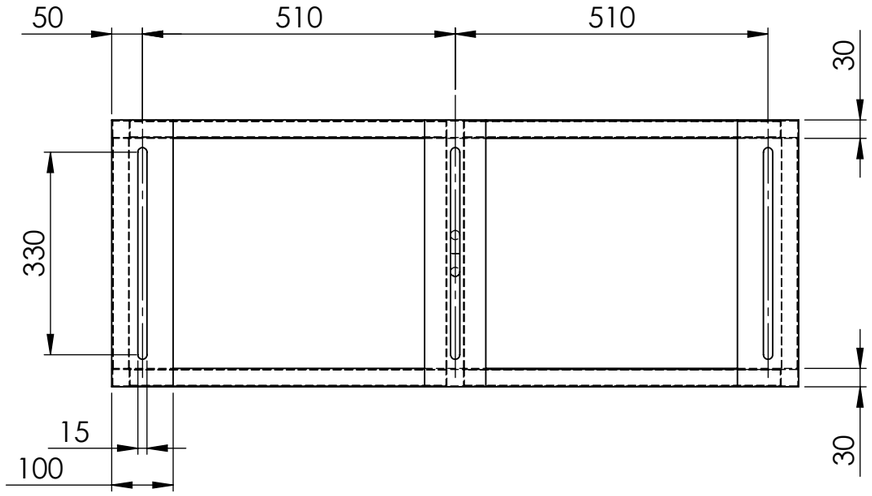
18. PPI

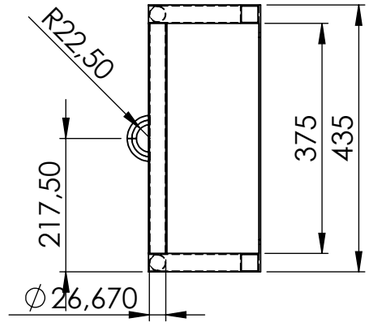
Net cash (NC) = benefits – costs =156.037,50€ - 17.151,30€ = 138.886,20€

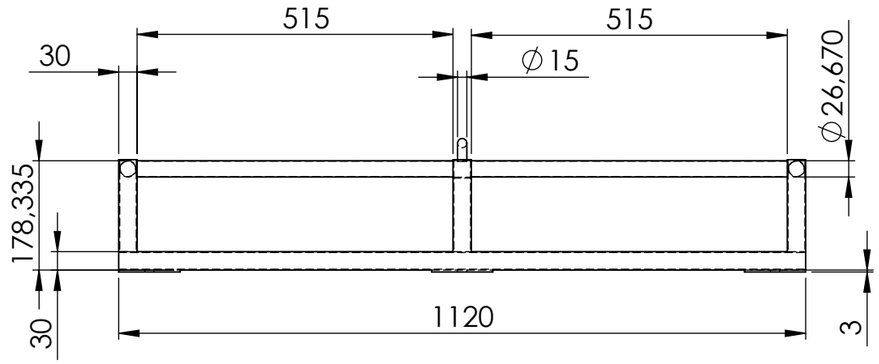
Monthly repayment = NC / 12 = 11.573,85€/month

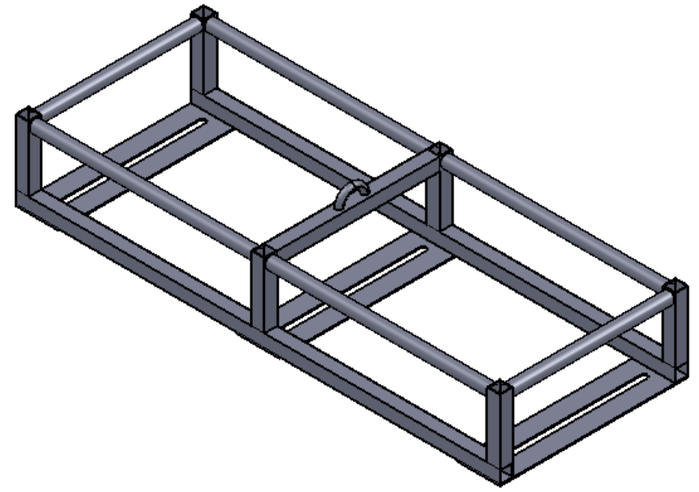
PPI =COSTS /MONTHLY REPAYMENT =17.151,30(€) / 11.573,85(€/month) =**1,48months**

The payback period of the investment will be approximately one month and fifteen days.

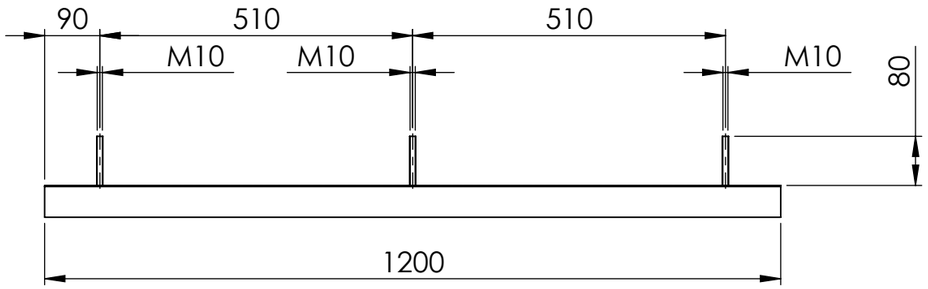


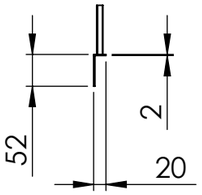


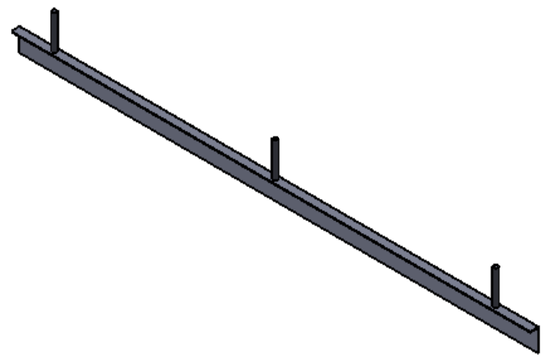




SI NO SE INDICA LO CONTRARIO: LAS COTAS SE EXPRESAN EN MM ACABADO SUPERFICIAL: TOLERANCIAS: -0 +0,5 LINEAL: ANGULAR:		ACABADO:			REBARBAR Y ROMPER ARISTAS VIVAS	NO CAMBIE LA ESCALA	REVISIÓN
	NOMBRE	FIRMA	FECHA			TÍTULO:	
DIBUJ.	Joan M.						
VERIF.	Joan M.						
APROB.	Toni G.						
FABR.	Comas						
CALID.				MATERIAL: EN 10083-2		N.º DE DIBUJO ÚTIL1	A3
				PESO: 11,5Kg		ESCALA:1:10	HOJA 1 DE 1







SI NO SE INDICA LO CONTRARIO: LAS COTAS SE EXPRESAN EN MM ACABADO SUPERFICIAL: TOLERANCIAS: -0 +0,5 LINEAL: ANGULAR:		ACABADO:			REBARBAR Y ROMPER ARISTAS VIVAS	NO CAMBIE LA ESCALA	REVISIÓN
	NOMBRE	FIRMA	FECHA			TÍTULO:	
DIBUJ.	Joan M.						
VERIF.	Joan M.						
APROB.	Toni G.						
FABR.	Comas						
CALID.				MATERIAL: EN 10083-2		N.º DE DIBUJO Perfil_L	A3
				PESO:		ESCALA:1:10	HOJA 1 DE 1

Anexo I

dalmec
Manipuladores Industriales

VIDRALA

C/ Garraf, Pol. Ind. Pla de la Bruguera
Castellar del Valles - Barcelona
Tel: 93 Fax: 93

A/A Sr. ANTONIO GARCIA
Jefes.turno.castellar@vidrala.com / 600 041 223

Oferta nº 11.434-02

Sr. Simone Beretta

Ripollet, a 02 de febrero de 2015

REF.: MANIPULADOR POSIFIL CON GANCHO.

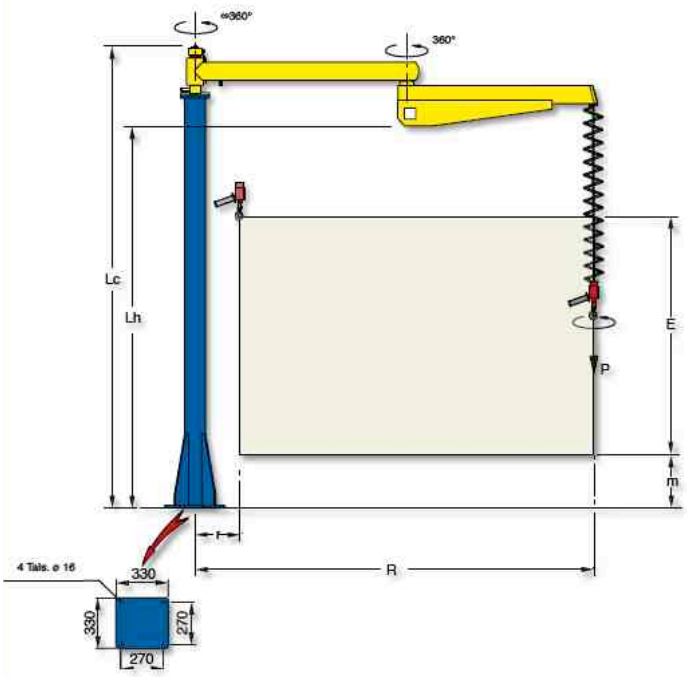
Señores:

De acuerdo con sus indicaciones y después de los datos facilitados, nos complace remitirles el siguiente estudio técnico - económico para el suministro de:

MANIPULADOR NEUMÁTICO DALMEC – POSIVEL

· Modelo **PVC-A26,** R-2.600mm a columna, con base autoestable preparada para transpaleta.

· Modelo especial equipado con implemento de toma tipo GANCHO o BRIDA DE ANCLAJE conectado al brazo horizontal mediante un cable de acero anti-torsión, para tomar cargas de un peso máximo de 60kg



Versiones estructurales: sobre base fija, sobre base auto estable suministrada por nosotros a la medida oportuna.

POSIVEL ejecución a columna "PVC"			
Carga máx.	P	50	Kg
Radio máx.	R	2200	mm
Radio mín.	r	200	mm
Recorrido	E	1400	mm
Altura mín.	m	300	mm
Límite superior	Lh	2100	mm
Límite inferior	Lc	2600	mm
Consumo	Por ciclo	10	Nl
Alimentación	Aire comprimido seco y sin lubricar. Mín. 0.7 MPa constante		

Las dimensiones y configuración del Manipulador puede variar en función de las necesidades específicas de cada Cliente.

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Manipuladores Industriales

VIDRALA
Oferta nº 11.434-02

· Modelo especial con brazo articulado y equipado con **GANCHO** estándar o **BRIBA de anclaje** para la manipulación de piezas con útiles del cliente.

Gancho estándar.

Brida para la adaptación de útil

· La compensación de las cargas del Manipulador, se obtienen mediante dos circuitos neumáticos que, previamente regulados, alimentan un cilindro a través de un relé de precisión. El primero de los circuitos se encarga de mantener siempre equilibrado el implemento de toma, el segundo compensa el peso de la carga a manipular.

· El brazo horizontal del Manipulador POSIVEL está articulado para facilitar los movimientos de la carga minimizando las inercias que provocan los pescantes, de modo que permite movimientos rápidos y precisos en todos los ejes del Manipulador.

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Manipuladores Industriales

VIDRALA
Oferta nº 11.434-02

· Para garantizar la durabilidad de nuestros Manipuladores, toda su estructura mecánica se somete a un estricto proceso de pintura que comprende los siguientes pasos:

- *Chorreado, desengrasado y fosfatado.*
- *Imprimación con dos capas de epoxi acrílico al agua.*
- *Acabado con dos capas de pintura epoxi bi-componente acrílico al agua.*

El proceso de pintura garantiza un espesor total mín. 90 µm., con una resistencia en cámara de niebla salina (s/ISO7253) ≈ 200 horas en nuestros siguientes colores estándares:

- Implemento: *RAL 3020 Rojo.*
- Manipulador: *RAL 1023 Amarillo*.
- Columna: *RAL 5010 Azul.*
- Vía de rodadura: *RAL 7005 Gris / Aluminio natural.*

N.B.: Bajo pedido, y con un costo de 280 ^{00} €/color, se pueden realizar acabados personalizados.

· Las soldaduras del Manipulador están realizadas por personal homologado con carnet TÜV.

SISTEMAS DE SEGURIDAD

· El Manipulador está equipado con los siguientes sistemas de seguridad.

- Acumulador de aire comprimido que, junto con una válvula antirretorno, facilita la finalización de la operación en curso en caso de corte del suministro de aire.
- Sistema de seguridad que ralentiza los movimientos ascendente-descendentes en caso de falsa maniobra por parte del operador.
- Dispositivo de Freno de todas las articulaciones y giros del Manipulador, accionado mediante un sistema neumático con presencia de operario o pulsador tipo seta con enclavamiento.

· DALMEC S.p.A. es una empresa certificada EN ISO 9001:2000

· Los Manipuladores DALMEC cumplen con las directivas de seguridad en Máquinas 89/392CEE, 91/368CEE.

DATOS TÉCNICOS

· Capacidad o peso máximo: 50Kg. (Incluido útil del cliente)
· Radio de trabajo: MÁXIMO 2.600mm.
· Alimentación: Aire comprimido a 7 bar constante, limpio, seco y sin lubricar.
. Recorrido vertical del gancho Manipulador: 1.400mm (400 a 1.800mm)
· Movimiento de la pieza: toma horizontal – suelta horizontal
· Altura libre en la zona de trabajo …mm (Por definir)

DOCUMENTACIÓN TÉCNICA

· Documentación Técnica definitiva, (después de las pruebas finales) (1 copia + documentación gráfica en soporte magnético, archivos formato PDF, Autocad DXF/DWG), constituida por:

- Diseño de conjunto del Manipulador (E=1:20), con identificación de los principales grupos de componentes.
- Diseño de conjunto del implemento de toma.
- Esquema neumático.
- Documentaciones de los catálogos de los componentes neumáticos.

- Libro de instrucciones para el montaje, uso y mantenimiento del Manipulador.
- Listado valorado de recambios recomendados para un año de trabajo.
- Manual de Instrucciones realizado de acuerdo con el párrafo 1.7.4 – Anexo I – R.D. 1435/1992: Directiva del Consejo 89/392CEE "Directiva Máquinas", que contiene en particular:
- Puesta en marcha.
- Instrucciones de uso.
- Dispositivos de Seguridad.
- Mantenimientos preventivos y extraordinarios.
- Localización de averías.
- Registros de control.
- Certificado de conformidad CE

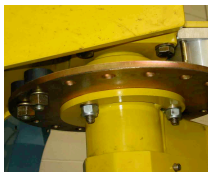
ENVIO DE MUESTRAS.

· En caso de su atento pedido, Uds deberían enviar a nuestra fábrica de CLES-TN (ITALIA) los siguientes materiales para pruebas técnicas y de fabricación. **El coste del envío no esta reflejado en la presente oferta.**

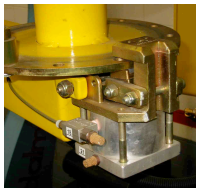
- **NO ES NECESARIO EL Envío DE MUESTRAS.**
- **Solo diseño de la garra, centro de gravedad, etc…**

ACCESORIOS COMPRENDIDOS EN EL MANIPULADOR

· **PRESELECTOR DE CARGA** completo, especialmente diseñado para la rápida regulación manual de cargas variables (pequeñas series). El Preselector de Carga está constituido por un robusto regulador de presión, disco de aluminio a modo de memoria visual y topes para delimitar el rango máximo-mínimo de la carga a equilibrar.

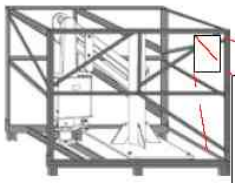


· **LIMITADOR DE GIROS**, mecánico en el eje de giro principal y secundario del Manipulador, constituido por un sistema de topes regulables, especialmente diseñado para limitar el ángulo de giro del Manipulador



· **DISPOSITIVO DE BLOQUEO**, especialmente diseñado para bloquear el Manipulador en todos sus ejes (principal, secundario, subida-bajada e implemento de toma). Constituidos por un sistema de frenos neumáticos de disco/mordaza, accionados por el operario mediante un único pulsador con enclavamiento o presencia de operario

· **PRE-ACEPTACIÓN DE LOS EQUIPOS,** a realizar en nuestra fábrica de CLES-TN Italia. Con simulación completa de la gama de trabajo. Facilita las eventuales modificaciones y/o regulaciones especiales, reduciendo sensiblemente el plazo de montaje, entrega y puesta en marcha. No están incluidos los desplazamientos hasta nuestra fábrica de Italia.



.EMBALAJE DEL MANIPULADOR descrito, compuesto por una jaula metálica desmontable y cajones de madera, que permiten un transporte, almacenamiento y montaje con total seguridad de los equipos.

· **PORTES DEL MANIPULADOR** descrito, incluido embalaje, seguros, etc..., hasta su planta de Barcelona.

· **MONTAJE** del Manipulador en su planta de Barcelona, a cargo de Personal Técnico de DALMEC, M.I.S.L. El suministro no comprende herramientas especiales, Señalización, etc…. Excluidos medios de elevación y transporte a pie de de obra(Carretilla elevadora)

· **PRUEBAS Y PUESTA EN MARCHA,** del equipo en la planta de Barcelona, realizadas por nuestro personal técnico (incluidos gastos de viaje, dietas y alojamiento).

CUMPLIMIENTO DE NORMAS

· Todos los trabajos se realizarán de acuerdo con la legislación Española y Europea.

· El Manipulador cumple con las siguientes disposiciones:

- *Directiva Máquinas **2006/42/CE** del 17 de mayo de 2006 que sustituye la Directiva Máquinas 91/368/CE, 93/44/CE y 93/68/CE, implementada en España s/**RD1644/2008***
- *Disposiciones mínimas de Seguridad y Salud s/**RD 1215/1997.***
- *Normas Armonizadas **EN.***
- *Después de la instalación y antes de la puesta en marcha, se hará*

entrega de la "Declaración de Conformidad" junto al Manual de Instrucciones, s/Anexos I - II de la Directiva Máquinas ***2006/42/CE Anexo I****.*

· *Para la instalación de los equipos, se observarán las siguientes disposiciones:*

- *Plan de Seguridad y Salud y Evaluación de Riesgos, de acuerdo con las disposiciones recogidas en el* ***RD 1627/1997*** *de 24 de octubre.*

GARANTÍAS

· La instalación tiene una garantía de 24 meses de duración, desde la fecha de puesta en marcha del equipo y no más de 24 meses desde la fecha de entrega. Esta garantía cubre los materiales, fabricación y montaje, mano de obra. Excluidos desplazamientos, dietas, etc…

· La garantía incluye la sustitución de los componentes defectuosos, franco su fábrica de Barcelona, s/condiciones Generales de DALMEC, M.I.S.L...

· Están excluidas de la garantía las piezas de normal desgaste.

ALCANCE DEL SUMINISTRO

· Responsabilidades de Dalmec M.I.S.L.

- Aportar el Material necesario para la instalación del/los Manipuladores y los materiales accesorios.
- Disponer de todas las herramientas necesarias para la instalación.
- Mantener el área de trabajo limpia, ordenada y señalizada.
- Garantizar el área de trabajo de los Manipuladores en carga y descarga de piezas.
- Cumplimiento de Normas y disposiciones.

· Responsabilidades de Vidrala.

- Espacio reservado para acopio de materiales.
- Estructuras y brida de anclaje en caso de instalar el/los manipuladores suspendidos fijos (si fuera necesario)
- Alimentaciones neumáticas (0.7-0.8 Mpa) a pié de Manipulador, finalizado con racor 3/8" macho. Dalmec definirá el punto exacto de la acometida.
- Facilitar informaciones detalladas y actualizadas de contenedores, mesas, máquinas y útiles relacionados con los Manipuladores. Esta información será definitiva al inicio del proyecto por parte de DALMEC. Las modificaciones de dicha información una vez iniciado o finalizado el

proyecto pueden suponer incrementos de costos que serán repercutidos al Cliente.

- Medios auxiliares de montaje, de elevación y acopio de materiales a pié de obra.

OFERTA ECONÓMICA

· Manipulador neumático POSIVEL **tipo A20** con gancho 60Kgs.
Importe ..... 6.654,00.-€.

· Dispositivo de equilibrio PRESELECTOR DE CARGA
Importe ..... 260,00.-€.

· Dispositivo de bloqueo CE.
Importe ..... INCLUIDO

· Dispositivo limitador de giros.
Importe ..... INCLUIDO

· Portes y montaje de los Manipuladores en lugar de instalación.
Importe ..... 900,00.-€.

· Pruebas y puesta en marcha del manipulador.
Importe ..... INCLUIDO

· Embalaje completo del manipulador.
Importe ..... INCLUIDO

· Documentación completa y certificado CE
Importe ..... INCLUIDO

Mandos duplicados

Importe.....840,00 €

IMPORTE TOTAL DEL SUMINISTRO RECOMENDADO..... *8.654,00.-€.***

*** Portes hasta Barcelona, Montaje del manipulador en Barcelona. No incluido el montaje de garras del cliente. Presupuesto supeditado a la verificación de los datos, y especificación técnica.*

dalmec
Manipuladores Industriales

OPCIONAL

Base autoestabile para transpalet

· **BASE AUTOESTABLE 1.200 X 1.200 X 60mm** que permite al Manipulador realizar su trabajo sin necesidad de anclarlo al pavimento. El Manipulador se fija a la Base Autoestable mediante tornillos M16, permitiendo su desplazamiento con un Transpalet. La base lleva unos estabilizadores y niveladores visuales de burbuja para su nivelación y un limitador de carga colocado en el manipulador como medida de seguridad. El limitador nos permite trabajar con un máximo de carga y en caso de imprudencia por parte del operario (coger cargas superiores a la máxima), el manipulador impedirá su manipulación.

Importe de base para Posivel Max 60kgs ..... 3.706,00.-€.

N.B: la Base Autoestable está desarrollada únicamente para el transporte del manipulador, NUNCA para desplazar el manipulador con la carga tomada.

· **MULTIPLICADOR DE PRESIÓN (BOOSTER),** permite el correcto funcionamiento del Manipulador con presión de aire en línea inferior a los 7-8 bar necesarios. Aumenta la presión hasta un rango hasta 9-10 bar. Soporte, manómetros, etc.

Importe ..... 1.700,00.-€/Und.

EXCLUIDO

· Descarga y aprovisionamiento de material a pie de línea.
· Utillajes especiales, adaptaciones especiales, regulaciones, etc…
· Medios auxiliares de montaje.
· Estructura de sustentación, soportes especiales, etc…
· Adecuación de la zona de trabajo.
. Obra civil.
· Acometidas de aire hasta lugar del manipulador.
· Documentaciones especiales no expuestas en el presente presupuesto
· IVA.

dalmec
Manipuladores Industriales

VIDRALA
Oferta nº 11.434-02

CONDICIONES DEL SUMINISTRO

· IMPORTES.- Franco Vidrala. – Castellar del Valles. Sobre camión.
· Excluido IVA.
· PLAZO DE ENTREGA: aprox 7-8 semanas laborables a partir de recepción del pedido, información para Ante-Proyecto y muestras.
· FORMA DE PAGO: 30% al pedido F.Fact
40% a la entrega del material F. Fact
30% a 60dias F. Fact
Recibo domiciliado
· VALIDEZ DE LA OFERTA.- 30 días.

Confiamos en que esta oferta merezca su interés y aprobación y, a la espera de sus noticias, quedamos de Vds. atentamente,

Anexo II

SERRALLERIA COMAS, S.L.

C / Terra Alta, 59 Pol. Ind. Carné
Apartat de Correus, 17
08211 - Castellar del Vallès
Barcelona
C.I.F.: B-62.110.366
serralleriacomas@hotmail.com

Castellar Vidrio S.A.
Sr. Joan
Castellar del Vallès
Barcelona

Obra: Taller Moldes

Pressupost Nº 2015 / 57 / 1

Castellar del Vallès 29/04/2015

QUANTITAT	DESCRIPCIÓ	PREU
	Construir util amb amb material inox	455 €/TOTAL

Nota: El 21% d' I.V.A, no está incluido en los precios
así como las modificaciones no reflejadas en este presupuesto
Esperando su respuesta les saluda atentamente
Debido al constante aumento de precios de fábrica, estos precios estan sujetos a revisión
Los aumentos serán repercutidos de forma inmediata.

Quick Exhaust Valve
Series AQ

Excellent exhaust characteristics

Hight flow capacity

Compact and light weight

A wide selection of models

Model

Model	Port size	Effective area (mm²)		Weight (g)
		INÆOUT	OUTÆEXH	
AQ1500-M5	M5	2	2.8	25
AQ1510-01	1/8	4	5.8	45
AQ2000-01	1/8	25	25	110
AQ2000-02	1/4	35	40	105
AQ3000-02	1/4	40	42	215
AQ3000-03	3/8	60	70	205
AQ5000-04	1/2	105	115	690
AQ5000-06	3/4	135	180	650

Specifications

Fluid		Air
Proof pressure		1.5MPa
Max. operating pressure	AQ15□0	0.7MPa
	AQ2000 to 5000	1MPa
Min. operating pressure	AQ15□0	0.1MPa
	AQ2000 to 5000	0.05MPa
Ambient and fluid temperature		– 5 to 60°C (No freezing)

How to Order

E AQ 2 0 0 0 – □ 02 – □

Standard size

1	1/8
2	1/4
3	3/8
5	3/4

Style

Symbol	Style	Model
0	Diaphragm	AQ2 to AQ5
5	Lip	AQ1 Only

Ordering source area code

-	Japan, Asia Australia
E	Europe
N	North America

Option

H	High temperature (-5 to 80°C)
L	Low temperature (-30 to 60°C)

Port size

Port size		Applicable series
M5	M5	AQ1500
01	1/8	AQ1510, 2000
02	1/4	AQ2000, 3000
03	3/8	AQ3000
04	1/2	AQ5000
06	3/4	

Thread

—	Metric thread (M5)
	Rc(PT)
N	NPT
F	G(PF)

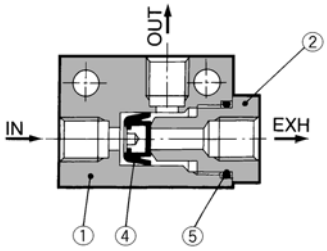
Standard

0	M5
1	1/8

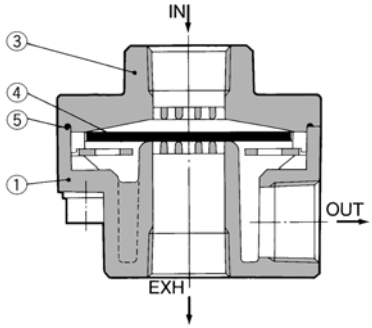
Note) "AQ15□0" only

Construction

AQ1500/1510



AQ2000/3000/5000



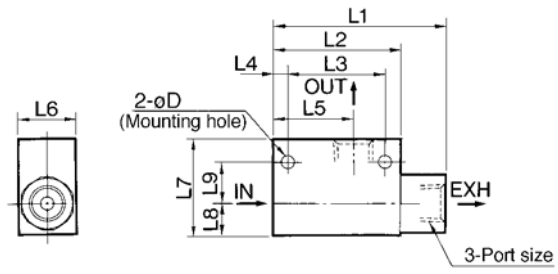
Component Parts

No.	Description	Material/Model		
		AQ1500	**AQ1510**	**AQ2000/3000/5000**
①	Body	Zinc die casted	Zinc die casted	Aluminum die casted
②	Guide	Brass	Brass	—
③	Cover	—	—	Aluminum die casted

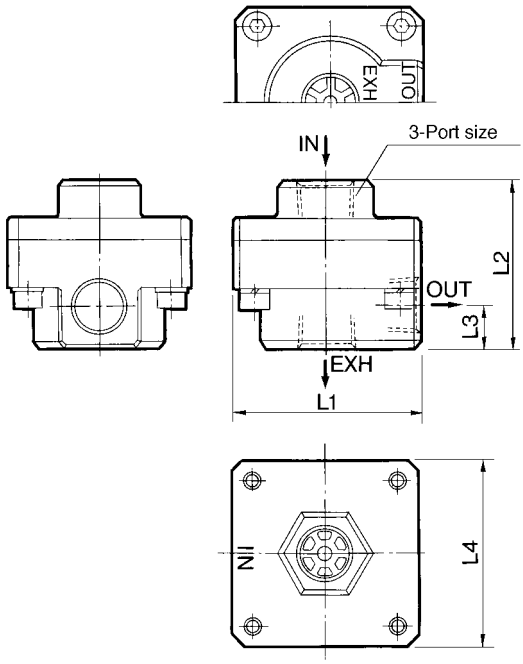
No.	Description	Material
④	Valve	NBR
⑤	O ring	NBR

Dimensions

AQ1500/1510



AQ2000/3000/5000



Model	Port size	L1	L2	L3	L4	L5	L6	L7	L8	L9	D
AQ1500	M5	23	20	14	3	12.5	12	15	5.5	6.5	3.1
AQ1510	1/8	45	33	25	4	21	15	25	8	11	4.3

Model	Port size	L1	L2	L3	L4
AQ2000	1/8, 1/4	45	40	10	45
AQ3000	1/4, 3/8	56	50	12.5	56
AQ5000	1/2, 3/4	85	75	18	85

Built-in One-touch Fittings

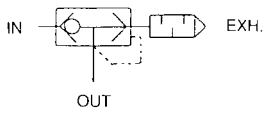
Quick Exhaust Valve

Series AQ240F/340F

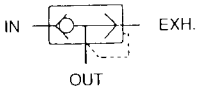
With silencer

With exhaust port fitting

JIS Symbol



With silencer



With exhaust port fittings

How to Order

AQ 2 4 0 F — 06 — 06

Quick exhaust valve

Body size

2	M5
3	1/8

In-line style

Built-in One-touch fittings

IN, OUT port applicable tube O.D.

04	ø4
06	ø6

Exhaust port

00	Built-in silencer
04	Applicable tube O.D. ø4
06	Applicable tube O.D. ø6

Note) Brass parts are all electroless nickel plated.

Space saving

Rectilinear IN-OUT tubing connections

- Built-in One-touch fittings and Silencer
- Light weight (Resin body)

Specifications

Proof pressure	1.5MPa
Max. operating pressure	1MPa
Min. operating pressure	0.1MPa
Ambient and fluid temperature	– 5 to 60°C (No freezing)
Applicable tubes(1)	Nylon, Soft nylon, Polyurethane

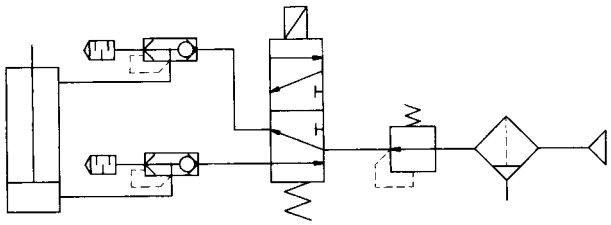
Note 1) Pay attention to the max. supply pressure for Soft nylon and Polyurethane.

Model

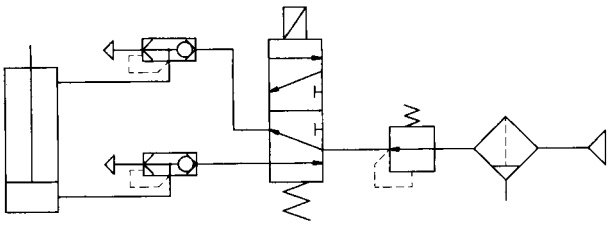
Model	Applicable tube O.D.		Effective area (mm^2)	
	4	6	IN→OUT	OUT→EXH.
AQ240F-04-☐	●		1.7	2.5
AQ240F-06-☐		●	2.4	2.7
AQ340F-06-☐		●	4	4

Circuit

With silencer



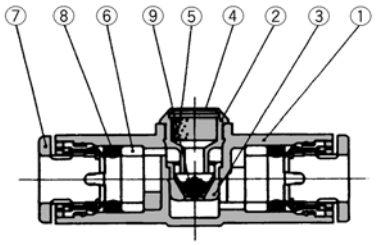
With exhaust port fittings



AQ240F/340F

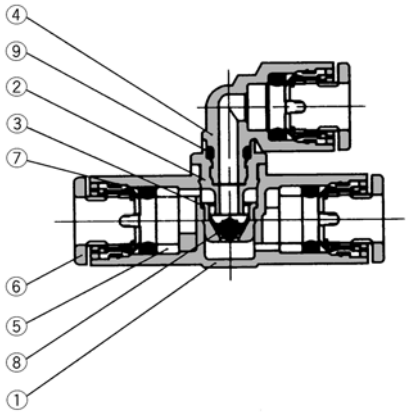
Construction

With silencer



No.	Description	Material	Note
①	Body A	PBT	
②	Seat ring	Brass	Electroless nickel plated
③	Valve seat	Brass	Electroless nickel plated
④	Silencer cover	SUS304	
⑤	Silencer	PVA sponge	
⑥	Spacer	POM	
⑦	Cassette	POM/Stainless steel	
⑧	Packing	NBR	
⑨	Valve	NBR	

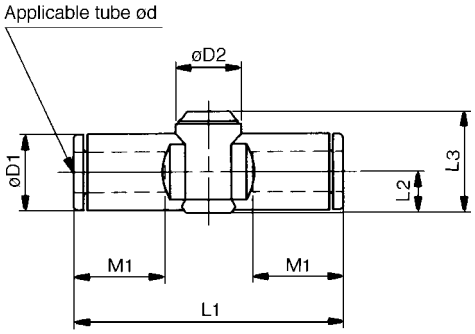
With exhaust port fitting



No.	Description	Material	Note
①	Body A	PBT	
②	Seat ring	Brass	Electroless nickel plated
③	Valve seat	Brass	Electroless nickel plated
④	Elbow union body	POM	
⑤	Spacer	POM	
⑥	Cassette	POM/Stainless steel	
⑦	Packing	NBR	
⑧	Valve	NBR	
⑨	O ring	NBR	

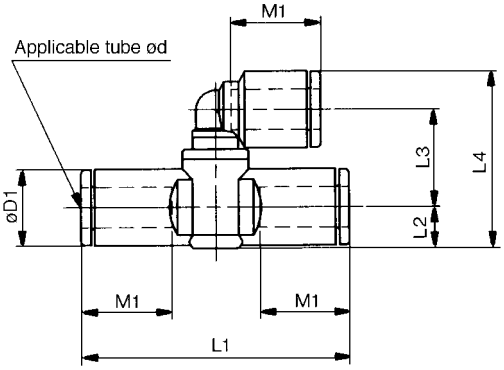
Dimensions

With silencer



Model	Tube O.D.ød	D1	D2	L1	L2	L3	M1	Wt.(g)
AQ240F-04-00	4	9.3	10.0	39.2	5.2	14.3	12.9	5
AQ240F-06-00	6	11.6	10.0	40.7	6.2	15.4	13.7	6
AQ340F-06-00	6	11.6	11.8	44.8	6.3	19.5	13.7	11

With exhaust port fitting

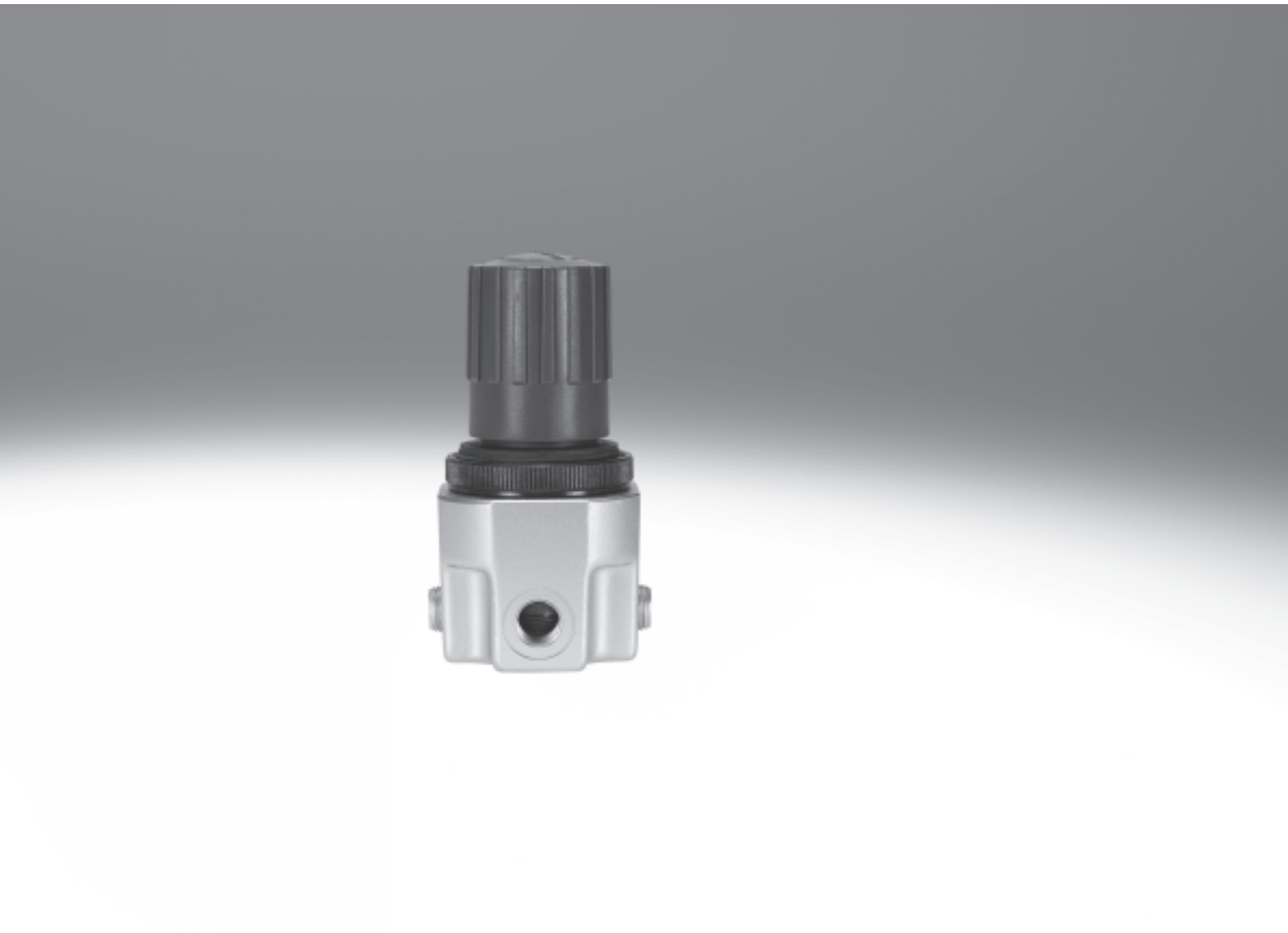


Model	Tube O.D.ød	D1	L1	L2	L3	L4	M1	Wt.(g)
AQ240F-04-04	4	9.3	39.2	5.2	13.7	23.5	12.9	6
AQ240F-06-06	6	11.6	40.7	6.2	14.7	26.7	13.7	8
AQ340F-06-06	6	11.6	44.8	6.3	19.6	31.7	13.7	13

ANEXO IV

Reguladores de presión LR/LRS

FESTO



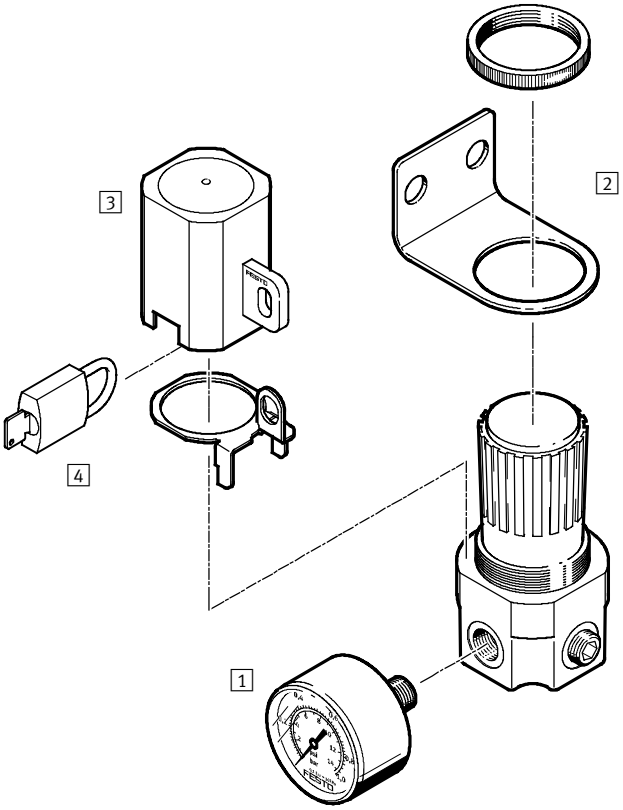
Reguladores de presión LR/LRS

Accesorios y referencias

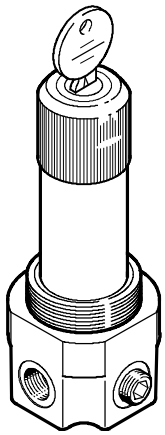
FESTO

Cuadro general de periféricos

Reguladores de presión LR



Regulador de presión LRS con llave



Elementos de fijación y accesorios		➔ Página/Internet
1	Manómetro MA	ma
2	Escuadras de fijación HR-D	7
3	Tapa de seguridad del regulador LRVS-G-⅛ con pasador de cierre	7
4	Candado LRVS-D	7

Código para el pedido

LR	–	⅛	–	G	–	7

Función de mantenimiento

LR	Regulador de presión
LRS	Regulador de presión, con llave

Conexión neumática

⅛	Rosca G⅛

Identificación de la versión

G	Identificación de la versión

Margen de regulación de la presión

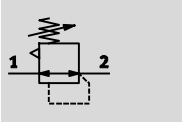
7	0,5 ... 7 bar
	0,5 ... 12 bar

Reguladores de presión LR/LRS

Hoja de datos

FESTO

Función



Caudal
600 ...700 l/min

Temperatura
–10 ... +80 °C

Presión de funcionamiento
1 ... 20 bar

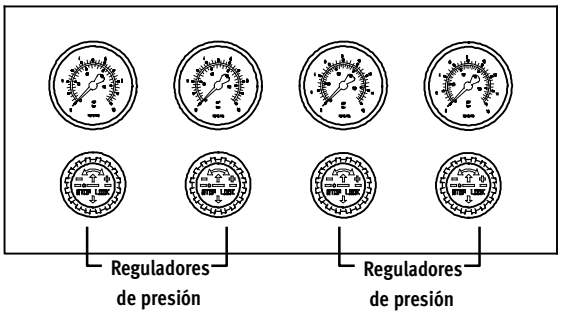
El regulador no contiene substancias perjudiciales para la pintura.

- Cuerpo de latón
- Gran caudal
- Regulador de membrana de gran precisión
- Botón giratorio con pasador de bloqueo
- Escuadra de fijación igual que de la serie D
- Para presiones iniciales hasta p1 = 20 bar
- Dos zonas de regulación de la presión:
  0,5 ... 7 bar y 0,5...12 bar

Estos reguladores mantienen la presión constante en el lado secundario independientemente de las variaciones que sufre la red neumática. El escape de aire en el lado secundario permite reducir la presión de funcionamiento sin unidades consumidoras.

Existen dos variantes del regulador:
- LR(S)-⅛-G para aplicaciones estándar.
- LR(S)-⅛-G-7 para aplicaciones especiales como, por ejemplo, controles con una presión de hasta 7 bar. Esta variante ofrece condiciones óptimas de caudal y regulación.

Montaje en panel frontal



Margen de regulación de la presión desde 0,5 hasta 7 bar

Margen de regulación de la presión desde 0,5 hasta 12 bar

Datos técnicos generales			
Tipo		LR(S)-⅛-G-7	LR(S)-⅛-G
Conexión neumática 1, 2		G⅛	
Construcción		Regulador de membrana con alimentación continua de presión	
Función de regulación		Presión inicial constante, con compensación de presión inicial, con escape secundario	
Tipo de fijación		Con accesorios	
		Montaje en línea	
		Montaje en panel frontal, taladro con diámetro de 36,5 mm	
Posición de montaje		Indistinta	
Seguridad contra accionamiento involuntario		Botón giratorio con pasador de bloqueo	
		Botón giratorio con cerradura incorporada	
Margen de regulación de la presión	[bar]	0,5 ... 7	0,5 ... 12
Histéresis máxima de la presión	[bar]	0,2	
Indicación de presión		G⅛ en preparación	

Caudal nominal normal qnN[1] [l/min]		
Margen de regulación de la presión	0,5 ... 7 bar	700
	0,5 ... 12 bar	600

1) Medición con p1 = 10 bar y p2 = 6 bar, Δp = 1 bar

Reguladores de presión LR/LRS

Hoja de datos

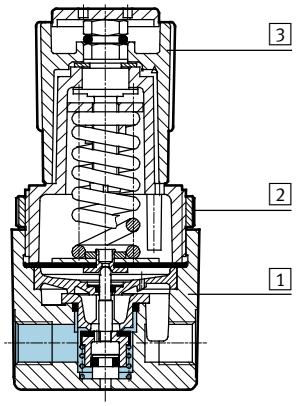
FESTO

Condiciones de funcionamiento y del entorno		
Presión de funcionamiento	[bar]	1 ... 20
Fluido de trabajo		Aire comprimido según ISO 8573-1:2010 [7:4:4]
Nota sobre el fluido de trabajo/mando		Es posible el funcionamiento con aire comprimido lubricado (lo cual requiere seguir utilizando aire lubricado)
Temperatura ambiente	[°C]	–10 ... +80
Temperatura del fluido	[°C]	–10 ... +80
Temperatura de almacenamiento	[°C]	–10 ... +80

Pesos [g]		
	LR	LRS
Regulador de presión	320	420

Materiales

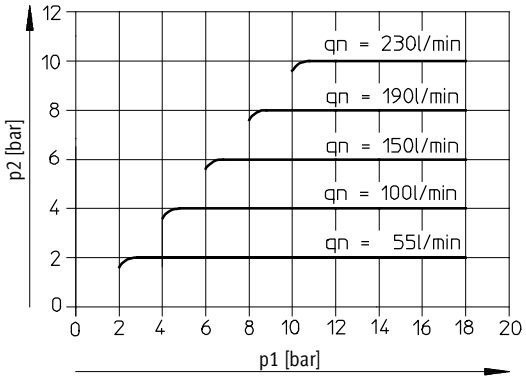
Vista en sección



Regulador de presión		
1	Cuerpo	Latón
2	Tuerca moleteada	Aluminio
3	Botón giratorio	PA
–	Juntas	NBR

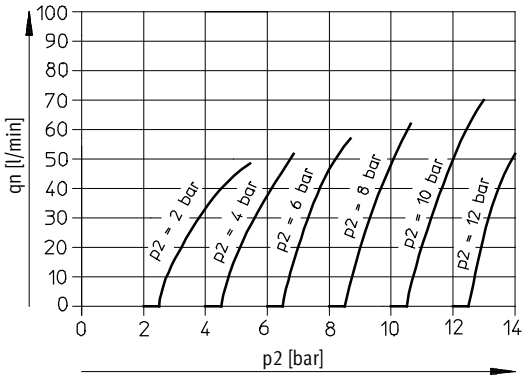
Compensación de la presión de entrada: presión de entrada p1 en función de la presión de salida p2

LR(S)-⅛-G(-7)



Descarga secundaria: presión de salida p2 en función del caudal normal qn

LR(S)-⅛-G(-7)



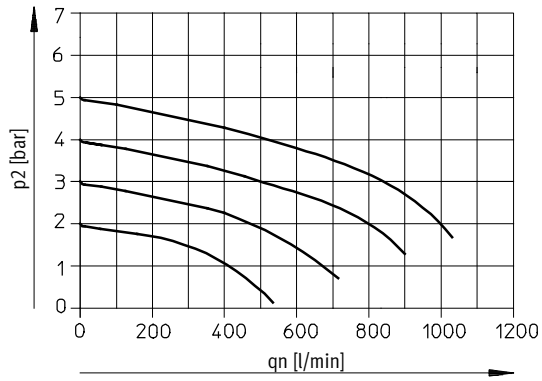
Reguladores de presión LR/LRS

Hoja de datos

FESTO

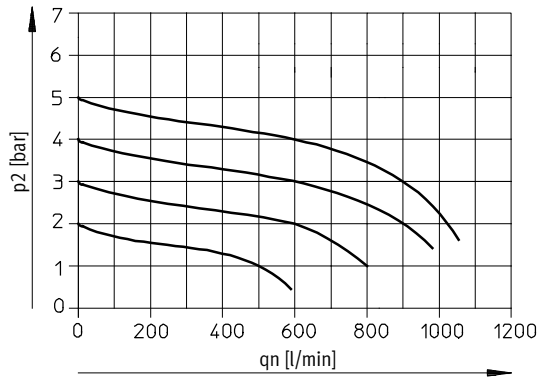
Caudal normal qn en función de la presión secundaria p2

LR(S)-⅛-G



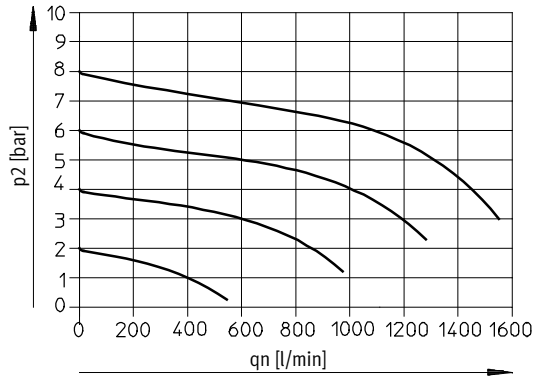
Presión de entrada p1 = 7 bar

LR(S)-⅛-G-7



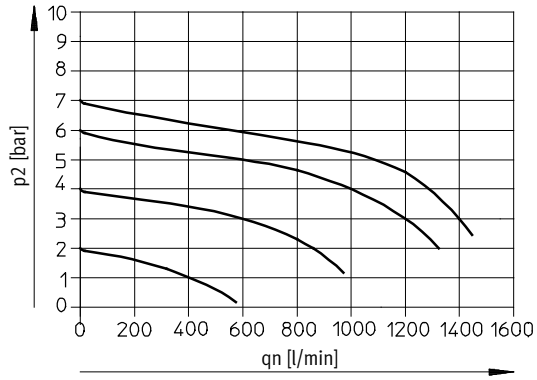
Presión de entrada p1 = 7 bar

LR(S)-⅛-G



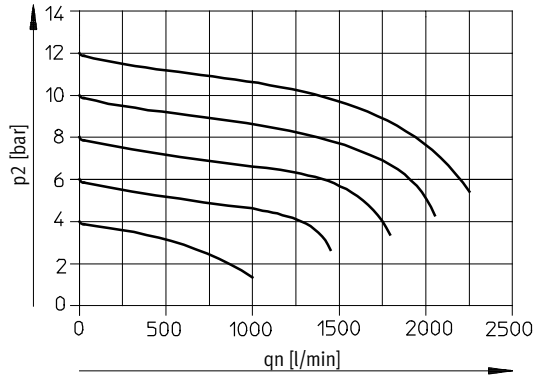
Presión de entrada p1 = 10 bar

LR(S)-⅛-G-7



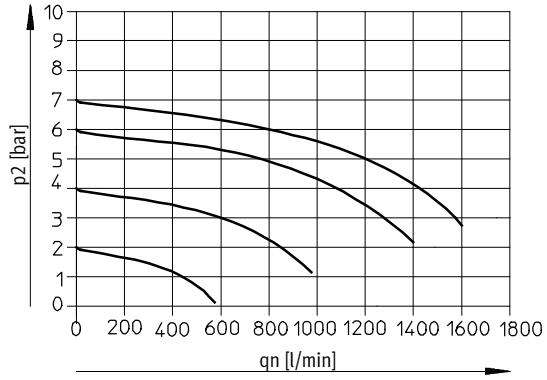
Presión de entrada p1 = 10 bar

LR(S)-⅛-G



Presión de entrada p1 = 14 bar

LR(S)-⅛-G-7



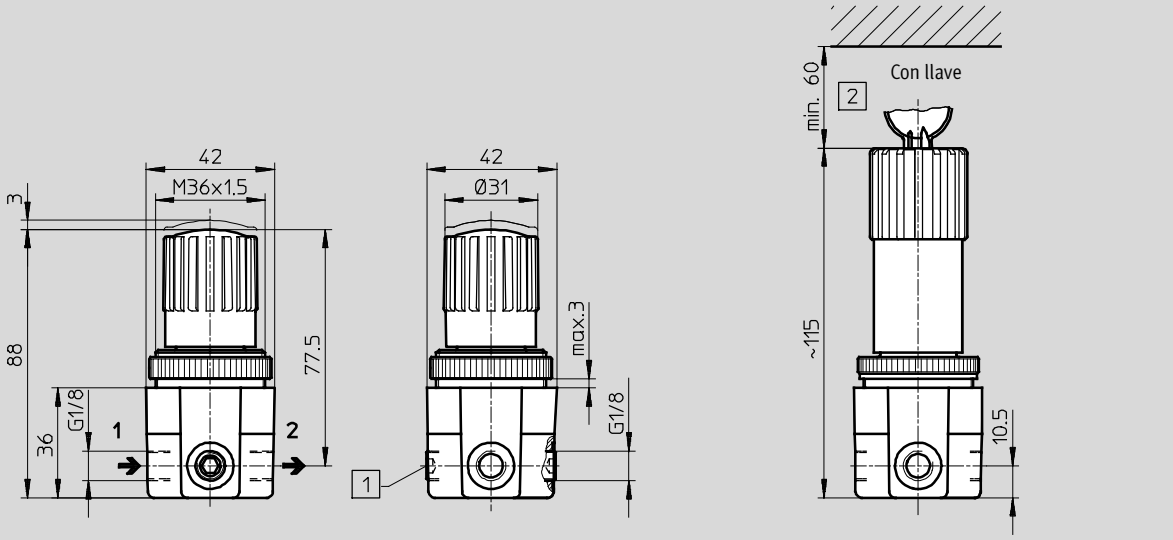
Presión de entrada p1 = 14 bar

Reguladores de presión LR/LRS

Hoja de datos

FESTO

Dimensiones Datos CAD disponibles en ➔ **www.festo.com**



1 Segunda conexión para manómetro

2 Medidas de instalación

➔ Sentido del flujo

Referencias

Conexión	Margen de regulación de la presión: 0,5 ... 7 bar		Margen de regulación de la presión: 0,5 ... 12 bar	
	Nº de artículo	Tipo	Nº de artículo	Tipo
G1/8	**159506**	**LR-1/8-G-7**	**159505**	**LR-1/8-G**
Con llave				
G1/8	**194695**	**LRS-1/8-G-7**	**194694**	**LRS-1/8-G**

Reguladores de presión LR/LRS

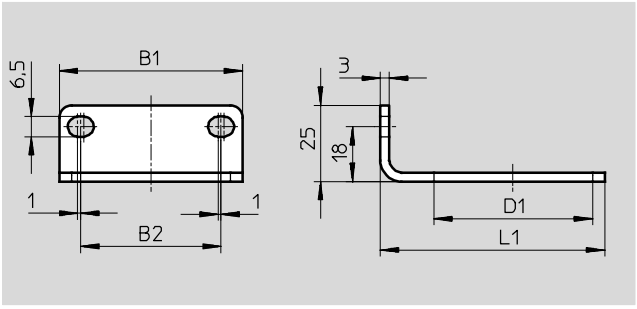
Accesorios

FESTO

Escuadras de fijación HR-D

Para montaje en la pared

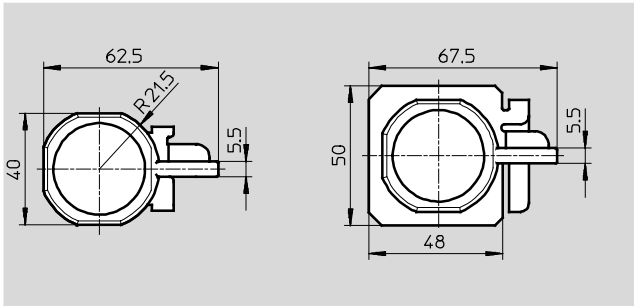
Material:
Acero cincado



Referencias

B1	B2	D1 ∅	L1	Nº de artículo	Tipo
42	28	36	57,5	**164936**	**HR-D-MINI**

Bloqueo del regulador LRVS



Referencias

Conexión	Peso [g]	Nº de artículo	Tipo
G1/8	36	**196080**	**LRVS-G-1/8**

Candado LRVS-D

Material:
Cuerpo: Latón

Temperatura ambiente:
–20 ... +60 °C

Referencias

Peso [g]	Nº de artículo	Tipo
120	**193786**	**LRVS-D**